

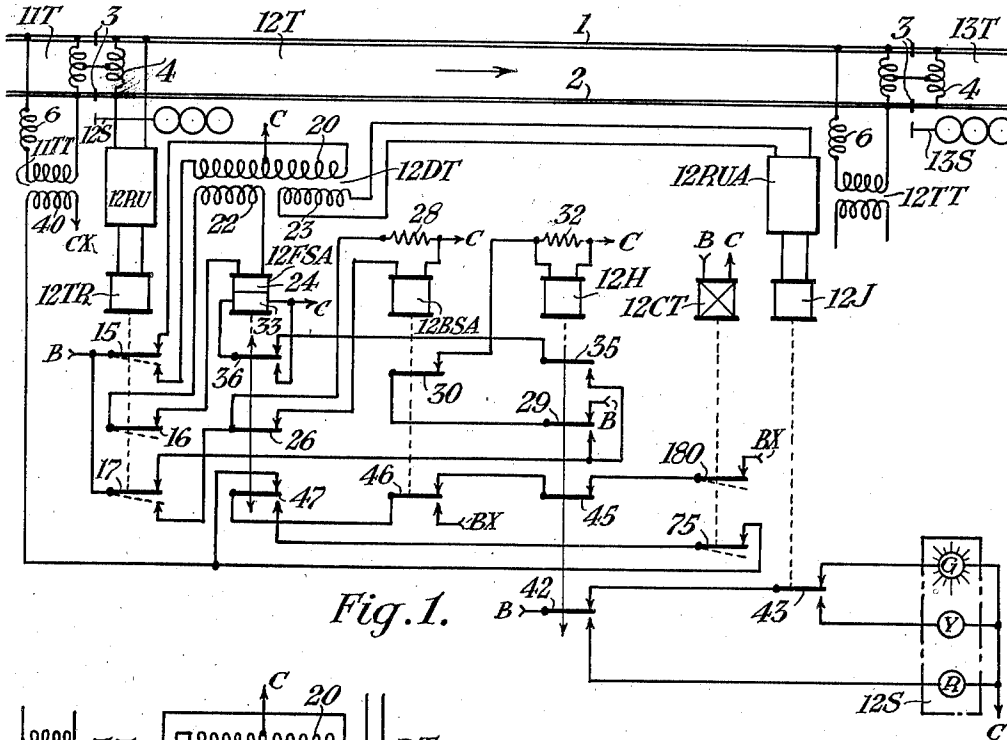
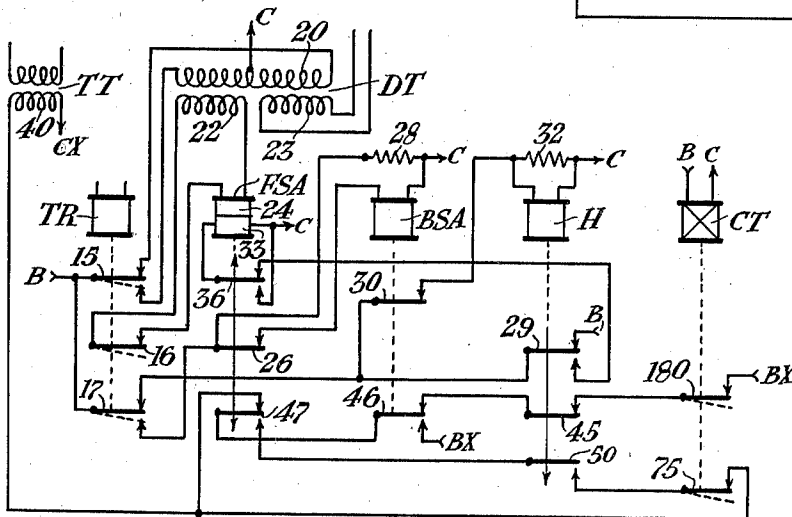
March 18, 1941.

L. R. ALLISON ET AL

2,235,134

RAILWAY SIGNALING SYSTEM

Filed Feb. 24, 1940



INVENTORS
 Leslie R. Allison and
 Frank H. Nicholson,
 by *Ad. Smith*
 THEIR ATTORNEY

UNITED STATES PATENT OFFICE

2,235,134

RAILWAY SIGNALING SYSTEM

Leslie R. Allison, Forest Hills, and Frank H. Nicholson, Penn Township, Allegheny County, Pa., assignors to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application February 24, 1940, Serial No. 320,654

20 Claims. (Cl. 246—38)

Our invention relates to a railway signaling system employing coded or periodically interrupted current, and particularly to improved means for protecting against improper operation of the system in the event an insulated joint separating two track sections becomes defective.

It has heretofore been proposed to provide means operable in the event the insulated joints separating two track sections are defective to establish a "lockout" circuit to supply steady uncoded energy to the section in the rear of the defective joints so that this energy will feed over the defective joints and maintain the track relay of the section in advance of the defective joints constantly energized to thereby cause the signal controlled by that track relay to display its most restrictive indication.

One means for accomplishing this result is shown in an application of Howard A. Thompson, filed May 28, 1938, Serial No. 210,743, for Railway traffic controlling apparatus, while another means for accomplishing this result is shown in an application of Ralph R. Kemmerer, filed June 30, 1939, Serial No. 282,185, for Railway signaling system.

The system shown in the application of Ralph R. Kemmerer is arranged so that it is non-cascading in operation, that is, if an insulated joint separating two sections becomes defective, and the equipment associated with the section in advance of the defective joint thereupon operates to establish the "lockout" circuit controlled thereby, and thus supply steady uncoded energy to the section in the rear of the defective joint, the equipment associated with such section in the rear will not operate to repeat the supply of steady uncoded energy to the section in the rear thereof, but will supply coded energy to such section in the rear.

It is an object of our invention to provide an improved signaling system incorporating a "lockout" circuit, the system being arranged so that it is non-cascading in operation, and also being arranged so that less equipment is required than is necessary in the system heretofore known.

A further object of our invention is to provide an improved signaling system incorporating a non-cascading "lockout" circuit, the system being arranged so that one relay performs the functions of a plurality of the relays employed in the system heretofore devised.

Another object of our invention is to provide an improved signaling system incorporating a non-cascading "lockout" circuit, the system being arranged so that none of the relays employed

therein are energized by current supplied over circuits including a back contact of the relay to which the current is supplied.

A further object of our invention is to provide an improved signaling system incorporating a "lockout" circuit, the system being arranged so that on shunting of the track relay of a section the supply of energy to the adjacent section in the rear is promptly interrupted in a manner such that energy cannot thereafter feed to such section in the rear until the contacts of all of the relays associated with the track relay have been released so that energy cannot feed over a defective joint and cause picking up of the contacts of the track relay with resultant interference with the intended mode of operation of the equipment.

Another object of our invention is to provide an improved railway signaling system.

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

We shall describe two forms of railway signaling apparatus embodying our invention, and shall then point out the novel features thereof in claims.

In the drawing,

Fig. 1 is a diagram showing a railway signaling system embodying our invention, and

Fig. 2 is a fragmentary diagram illustrating a modification of the system shown in Fig. 1.

Referring to Fig. 1 of the drawing, there is shown therein a stretch of railway track having track rails 1 and 2 over which traffic normally moves in the direction indicated by the arrow, that is, from left to right. The rails of the track stretch are separated by insulated joints 3 into the customary successive track sections, and the rails of each of these sections form a part of a track circuit of the usual character.

The particular track stretch which is represented in Fig. 1 of the drawing is intended for use in a railway system employing electric current for propulsion purposes, and for this reason alternating current track circuit energy is used together with impedance bonds 4 of the customary form which conduct propulsion current around each pair of insulated rail joints. As the description proceeds, however, it will be apparent that the apparatus of our invention is equally well suited for use on a steam road, in which the application of either direct or alternating current track circuit energy for the control of the signals may be employed. In such

an application the impedance bonds 4 would, of course, be omitted.

In the diagram comprising Fig. 1 of the drawing one complete track section, which is identified as section 12T, and parts of two other sections, identified as sections 11T and 13T, are shown. Each of these sections has located at the entrance end thereof a signal for governing movement of trains in the track stretch, the signal for section 12T being identified as 12S. The signal illustrated is of the familiar color light type having a green or proceed lamp G, a yellow or caution lamp Y, and a red or stop lamp R. It should be understood, however, that the invention is not restricted to the use of a signal of this type, and that any appropriate kind of signal may be employed.

The rails of each track section form a part of a track circuit to which coded alternating current signal control energy is supplied at the exit or leaving end from the secondary of a track transformer TT with a prefix corresponding to that of the associated track section. The circuits for supplying current from the secondary winding of the track transformers include the usual current limiting reactors 6. The energy supplied to the track circuits is derived from any suitable source and may be distributed throughout the track stretch by a transmission line, not shown. In the drawing the terminals BX and CX designate the terminals of such power supply source, and it will be assumed that the energy supplied from the source is alternating current with a frequency of 100 cycles per second.

Each of the signal locations has associated therewith a suitable source of direct current, such as a primary or storage battery, not shown, the terminals of which are designated in the drawing by the reference characters B and C.

The particular signaling system shown in Fig. 1 is of the three-indication variety and it makes use of track circuit energy coded at two different frequencies. This coded energy is provided by code transmitters CT which interrupt the supply circuits for the associated track transformers a definite number of times a minute according to traffic or other conditions ahead. In the illustrative form shown each code transmitter CT is provided with two circuit making and breaking contacts 75 and 180, which are continuously actuated by a motor or other suitable mechanism at two different speeds. For purposes of illustration it will be assumed that these speeds are such as respectively to provide 75 and 180 energy pulses per minute which are separated by periods of equal duration in which no energy is supplied.

Each of the track sections includes a code following track relay designated TR together with an appropriate prefix. The track relay is located at the entrance end of the track section and may be of any suitable type. As shown, the relay is of the direct current type, having its winding connected to the track rails of the associated track section through a suitable resonant unit RU shown diagrammatically in the drawing.

The resonant units RU each comprise a transformer, a capacitor, and a reactor so arranged and proportioned as to freely pass the 100 cycle coded signal control energy, but so as not to pass propulsion current of a different frequency. Each resonant unit includes, in addition, a rectifier which converts into direct current the alternating current which is supplied through the unit.

The track relay 12TR has associated there-

with auxiliary relays 12FSA, 12BSA, 12H and 12J, and a decoding transformer 12DT, while each of the other signals in the track stretch has associated therewith equipment corresponding to that associated with signals 12S.

The track relay 12TR has a contact 15 which controls the supply of energy from the local source of direct current to the two end portions of the primary winding 20 of the decoding transformer 12DT, while the track relay has a contact 16 which when in its picked-up position establishes a circuit to supply energy from the transformer secondary winding 22 to the pick-up winding 24 of the relay 12FSA.

In addition the track relay 12TR has a contact 17 which controls circuits for supplying energy to the relays 12BSA and 12H, and to the holding winding 33 of the relay 12FSA.

The decoding transformer 12DT has a secondary winding 23 which is connected through a 20 resonant unit 12RUA to the relay 12J.

The resonant unit 12RUA includes an inductance and a capacitance which are arranged and proportioned so that when the frequency of the current supplied thereto is that which is present when the track relay is responding to energy of the 180 code frequency sufficient energy is supplied through the unit to pick up the contact of relay 12J. The elements of the resonant unit are also arranged so that when the unit is supplied with energy of the frequency present when the track relay is responding to energy of a different code frequency, such as 75 code frequency, insufficient energy is supplied to the winding of relay 12J to maintain the relay contacts picked up.

The resonant unit 12RUA includes a rectifier which rectifies the current which is supplied through the unit.

The relays 12FSA, 12BSA and 12H cooperate in the manner hereinafter described in detail to control the supply of energy to the primary winding 40 of track transformer 11TT, while the relays 12H and 12J cooperate to control the circuits of the lamps G, Y and R of signal 12S.

The equipment is shown in the condition which it assumes when the track stretch is vacant for at least one track section in advance of section 12T. At such times energy of the 180 code frequency is supplied to the transformer 12TT by the equipment associated with section 13T. The equipment associated with section 13T operates in the manner hereinafter described in detail in connection with the equipment associated with section 12T.

As energy of the 180 code frequency is supplied to the transformer 12TT, energy of this code frequency feeds to the track relay 12TR and effects code following operation of the contacts thereof at this frequency with the result that current is induced in the secondary windings 22 and 23 of the transformer 12DT.

As explained above during the picked up periods of the track relay contacts, contact 16 establishes a circuit to supply impulses of current from the secondary winding 22 to the pick-up winding 24 of relay 12FSA, and as a result the relay 12FSA is maintained picked up. The relay 12FSA has a slow releasing characteristic such that the relay will remain picked up during the intervals between the supply of impulses of current to the relay winding.

As relay 12FSA is picked up, contact 26 establishes the circuit for supplying energy to relay 12BSA, and impulses of current are supplied to

the winding of this relay during the released periods of track relay contact 17. In addition, the circuit for connecting the snubbing resistor 28 across the terminals of the relay winding is completed, and, accordingly, the relay 12BSA is rendered slow in releasing and remains picked up during the intervals in which the contact 17 is in its picked up position.

As relay 12BSA is picked up energy is supplied to relay 12H over the stick circuit which is traced from terminal B through front contact 29 of relay 12H, front contact 30 of relay 12BSA, and winding of relay 12H to terminal C. The snubbing resistor 32 renders the contacts of relay 12H slow in releasing.

Since the track relay 12TR is responding to energy of the 180 code frequency, the frequency of the current induced in the secondary winding 23 of decoding transformer 12DT is such that the resonant unit 12RUA passes sufficient current to the relay 12J to maintain the relay picked up.

As relays 12H and 12J are both picked up, the circuit for supplying current to the green or proceed lamp G of signal 12S is complete, and this lamp is illuminated to indicate to an approaching train that there are at least two clear sections in advance of the signal 12S. The circuit of the lamp G is traced from terminal B through front contact 42 of relay 12H, front contact 43 of relay 12J, and lamp G to terminal C.

As relays 12FSA, 12BSA and 12H are all picked up, the circuit for supplying energy of the 180 code frequency to the primary winding 40 of track transformer 11TT is complete, and is traced from terminal BX through contact 180 of code transmitter 12CT, front contact 45 of relay 12H, front contact 46 of relay 12BSA, and front contact 47 of relay 12FSA to one terminal of the primary winding 40, the other terminal of which is connected to terminal CX.

As a result of the supply of energy of the 180 code frequency to the primary winding 40 of the track transformer 11TT, the secondary winding of this transformer supplies current of this code frequency to the rails of section 11T.

Operation of equipment on movement of a train in the normal direction of traffic

If a train moving in the normal direction of traffic enters section 12T, it shunts the track relay 12TR with the result that current is not induced in the secondary windings 22 and 23 of transformer 12DT, while track relay contact 16 interrupts the circuit for supplying current from transformer winding 22 to the winding 24 of relay 12FSA. Accordingly relays 12FSA and 12J become released after a short time interval.

On release of relay 12FSA, which, as explained above, occurs a short time subsequent to the shunting of the track relay, contact 26 interrupts both the circuit for supplying energy to relay 12BSA, and the circuit for connecting the snubbing resistor 28 across the terminals of the relay winding, with the result that relay 12BSA thereupon quickly releases.

On release of relay 12BSA contact 30 interrupts the circuit for energizing relay 12H, and relay 12H releases after a time interval determined by the release time of the relay.

As a result of the release of relay 12H, contact 42 interrupts the circuit of the green lamp G and establishes the circuit of the red lamp R. This circuit is traced from terminal B through back

contact 42 of relay 12H, and lamp R to terminal C.

On release of relay 12FSA contact 47 interrupts the circuit for supplying energy of the 180 code frequency to the track transformer 11TT, while on release of contact 46 of relay 12BSA the circuit for supplying energy of the 75 code frequency to the track transformer 11TT is established. This circuit is traced from terminal BX through back contact 46 of relay 12BSA, back contact 47 of relay 12FSA, and contact 75 of the code transmitter 12CT to one terminal of the winding 40 of the transformer 11TT, the other terminal of which is connected to terminal CX.

When the train advances in the track stretch far enough to enter section 13T, it shunts the track relay for that section with the result that signal 13S is caused to display its red or stop indication, while energy of the 75 code frequency is supplied to the track transformer 12TT.

As long as any portion of the train remains in section 12T, the track relay 12TR continues to be shunted, but when the rear of the train vacates section 12T, the energy of 75 code frequency supplied by the transformer 12TT feeds to the track relay 12TR and effects code following operation thereof.

On picking up of the track relay 12TR contact 15 interrupts the circuit for energizing the left-hand portion of the primary winding 20 of the transformer 12DT, and establishes a circuit for supplying current to the right-hand portion of the winding 20. As a result of this change in the energization of the winding 20, an impulse of current is induced in the secondary winding 22, while as contact 16 of relay 12TR is picked up, an impulse of current is supplied from the winding 22 to the pick-up winding 24 of relay 12FSA.

The relay 12FSA has a slow pick-up characteristic, while picking up of the relay contacts is additionally delayed because the holding winding 33 of the relay is short circuited at this time since contact 36 of the relay is released.

The transformer 12DT and the relay 12FSA are selected and proportioned so that one impulse of current supplied from the transformer winding 22 to the relay winding 24 does not build up sufficient magnetic flux in the relay core to effect picking up of the relay contacts. Accordingly the contacts of relay 12FSA remain released on the first picked up period of the track relay contacts.

On the first "off" period following the first "on" period in the code supplied to the track relay 12TR, the contacts of that relay become released, and, while there is a change in the energization of the transformer primary winding 20 so that an impulse of current is induced in the secondary winding 22, no current is supplied to the winding 24 of the relay 12FSA at this time because contact 16 of relay 12TR is released.

On the next or second "on" period in the code supplied to the track relay 12TR, its contacts again become picked up and another impulse of current is induced in the secondary winding 22 of the transformer 12DT, and another impulse of current is supplied from the secondary winding 22 to the winding 24 of relay 12FSA.

At the time the second impulse of current is supplied to the winding 24 of relay 12FSA the magnetic flux built up in the relay core as a result of the supply of the first impulse of current to the relay winding will not have completely died down, and because of the presence

of this magnetic flux remaining from the first impulse of current supplied to the relay winding, when the second impulse of current is supplied to the relay winding, the flux in the relay core is built up to a value high enough to effect picking up of the relay contacts.

Accordingly on the second picked up period of and contact 36 interrupts the circuit for short the track relay contacts relay 12FSA picks up, circuiting the holding winding 33 of relay 12FSA.

On picking up of contact 36 of relay 12FSA it engages its front contact to establish the circuit to supply energy to the holding winding 33 to assist in maintaining the relay contacts picked up. The circuit for supplying energy to the winding 33 of relay 12FSA is complete at the time of picking up of contact 36 since track relay contact 17 is picked up. This circuit is traced from terminal B through front contact 17 of track relay 12TR, back contact 35 of relay 12H, front contact 36 of relay 12FSA, and winding 33 of relay 12FSA to terminal C.

The windings 33 and 24 of relay 12FSA are arranged so that when energy is supplied to the winding 33 it assists the winding 24 in maintaining the relay contacts picked up. Accordingly on picking up of relay 12FSA, with the resultant supply of energy to the holding winding 33 of the relay, additional force is available to maintain the contacts of the relay picked up. This serves to prevent bobbing action of the relay contacts once they become picked up.

The supply of energy to the holding winding 33 of relay 12FSA is interrupted on release of contact 17 of the track relay 12TR, which occurs shortly after picking up of the contacts of relay 12FSA, so that the supply of energy to the winding 33 of relay 12FSA is continued only for a brief period, but this period is sufficiently long to insure that the relay contacts will be maintained picked up.

In addition, on picking up of relay 12FSA contact 47 interrupts the previously traced circuit for supplying energy of the 75 code frequency to the transformer 11TT, and establishes the "lock-out" circuit to supply steady uncoded energy to the winding 40. This circuit is traced from terminal BX through back contact 46 of relay 12BSA, and front contact 47 of relay 12FSA to one terminal of the winding 40.

On picking up of contact 26 of relay 12FSA the circuit to a terminal of relay 12BSA is partially established, and on the next or second "off" period in the code supplied to the track relay 12TR, an impulse of energy is supplied to relay 12BSA over the circuit which includes back contact 17 of the track relay 12TR. On the supply of current to relay 12BSA this relay picks up, and at this time the snubbing resistor 28 is connected across the terminals of the winding of the relay so that the relay is slow in releasing and remains picked up during subsequent picked up periods of the track relay contacts.

On picking up of relay 12BSA contact 46 interrupts the circuit for supplying steady uncoded energy to the transformer 11TT and establishes the circuit through which energy of the 180 code frequency is supplied to the transformer 11TT as soon as contact 45 of relay 12H becomes picked up.

On picking up of contact 30 of relay 12BSA the pick-up circuit is established to supply energy to relay 12H on the next or third picked up period of the track relay contacts.

On the next or third picked up period of the track relay contacts, contact 17 engages its front contact and current is supplied to relay 12H over the pick-up circuit which is traced from terminal B over front contact 17 of track relay 12TR, back contact 29 of relay 12H, front contact 30 of relay 12BSA, and the winding of relay 12H to terminal C of the source of current. As soon as energy is supplied to relay 12H, this relay picks up and contact 29 interrupts the above traced pick-up circuit, while contact 29 establishes the stick circuit to maintain relay 12H energized as long as contact 30 of relay 12BSA is maintained picked up.

On picking up of contact 35 of relay 12H the previously traced circuit for supplying energy to the holding winding 36 of relay 12FSA is interrupted, while on picking up of contact 45 of relay 12H the circuit for supplying energy of the 180 code frequency to the transformer 11TT is complete and energy of this frequency is now supplied to the rails of section 11T.

At this time as the track relay 12TR is responding to energy of the 75 code frequency, the current induced in secondary winding 23 of the decoding transformer 12DT is of such frequency that too little energy is supplied through the resonant unit 12RUA to relay 12J to pick up that relay, and, accordingly, its contact 43 remains released. As a result, on picking up of contact 42 of relay 12H the circuit for illuminating the red or stop lamp R is interrupted, and the circuit is established to supply current to the yellow or caution lamp Y of the signal 12S. This circuit is traced from terminal B through front contact 42 of relay 12H, back contact 43 of relay 12J, and lamp Y to terminal C.

As long as the track relay 12TR continues to respond to energy of the 75 code frequency, the relay 12FSA is maintained picked up by the impulses of current supplied to the winding 24 of the relay during the picked up periods of the track relay contacts, while the contacts of relay 12BSA are maintained picked up by energy supplied to the relay winding during the released periods of the track relay contacts. The contacts of relay 12H are held picked up by energy supplied to the relay winding through the stick circuit for the relay.

When the train has advanced far enough in the track stretch to clear section 13T, energy of the 75 code frequency is supplied to the rails of that section, while the equipment associated therewith operates in the manner described in detail in connection with section 12T to condition the signal 13S to display its yellow or caution indication, and to supply energy of the 180 code frequency to the rails of section 12T. On this change in the frequency of the coded current supplied to section 12T there is a corresponding change in the rate of operation of the contacts of track relay 12TR, and in the frequency of the current induced in secondary winding 23 of transformer 12DT, with the result that sufficient energy is supplied to relay 12J to pick up. On picking up of contact 43 of relay 12J the circuit for illuminating the yellow or caution lamp Y of signal 12S is interrupted, and the circuit for illuminating the green or proceed lamp G is established.

The normal operation of the equipment having been explained, its operation in the event an insulated joint separating two track sections becomes defective will now be considered.

Operation of the equipment in the event an insulated joint breaks down as a result of passage of a train

For purposes of illustration it will be assumed that the track stretch is vacant so that energy of the 180 code frequency is supplied to the rails of section 12T, that a train moving in the normal direction of traffic passes through the track stretch, and that an insulated joint 3 separating sections 11T and 12T breaks down as a result of passage of the train.

In electrified territory, because of the well-known operation of the impedance bonds 4, breaking down of one insulated joint has the same effect as breaking down of both insulated joints in steam propulsion territory, and permits the impulses of signal control current supplied to the section in the rear of the defective joint to feed to the track relay of the section in advance of the defective joint.

When the train under consideration enters the section 12T, it shunts the track relay 12TR and the equipment associated therewith operates in the manner heretofore explained in detail to condition the signal 12S to display its red or stop indication, while energy of the 75 code frequency is supplied to the transformer 11TT.

When the train advances in the track stretch far enough for the rear end thereof to be located in advance of the track relay 12TR, impulses of energy supplied to the rails of section 11T will feed over the defective insulated joint 3 to the winding of relay 12TR, but because of the shunting action of the wheels and axles of the vehicle forming the train, too little current will be supplied to the track relay to pick it up.

However, as soon as the train has advanced far enough in the track stretch for the rear end of the train to be located some distance in advance of the point of connection of the winding of the track relay 12TR with the track rails of the section 12T, the shunting action of the train is reduced, and relay 12TR picks up as a result of the impulses feeding over the defective joint 3.

On the first movement of the track relay contacts to their picked up position an impulse of current is induced in the secondary winding 22 of transformer 12DT, while contact 16 of the track relay establishes the circuit to supply current from the winding 22 to winding 24 of the relay 12FSA.

As previously explained, however, relay 12FSA will not pick up on the supply of the first impulse of current thereto. Accordingly the relay contacts remain released at this time.

However, on the next or second picked up period of the track relay contacts another impulse of current is supplied to the winding 24 of relay 12FSA and the relay picks up.

On picking up of relay 12FSA contact 47 interrupts the circuit for supplying energy of the 75 code frequency to the transformer 11TT, and establishes the "lockout" circuit for supplying steady uncoded energy to the transformer 11TT. This circuit is traced from terminal BX through back contact 46 of relay 12BSA, front contact 47 of relay 12FSA, and winding 40 of transformer 11TT to terminal CX.

On the supply of steady uncoded energy to the track transformer 11TT steady energy is supplied to the rails of section 11T, and feeds over the defective insulated joint 3 to maintain the track relay 12TR steadily picked up.

As previously explained, when relay 12FSA picks up and relay 12H is released and the track

relay 12TR is picked up, a circuit is established to supply energy to the holding winding 33 of relay 12FSA. This circuit is traced from terminal B through front contact 17 of the track relay 12TR, back contact 35 of relay 12H, front contact 36 of relay 12FSA, and holding winding 33 to terminal C.

The energy supplied to the holding winding 33 of relay 12FSA serves to maintain the relay picked up after the supply of energy to the pick-up winding 24 of the relay ceases, due to relay 12TR becoming steadily energized.

Since relay 12FSA is maintained picked up by its holding winding 33, contact 47 maintains the "lockout" circuit for supplying steady uncoded energy to the rails of section 11T, and this energy feeding over the defective insulated joint 3 maintains the track relay 12TR steadily picked up with the result that contact 17 maintains the circuit for the holding winding 33 of relay 12FSA.

It will be seen, therefore, that under these conditions the "lockout" circuit is established and will be maintained. As the track relay is held steadily picked up, energy is not supplied to relays 12BSA and 12H and these relays remain released, while the signal 12S continues to display its red or stop indication.

On the supply of steady energy to the rails of section 11T the contacts of the track relay for that section are maintained steadily picked up, and the signal for that section is conditioned to display its red or stop indication, but, as herein-after explained in detail in connection with section 12T, energy of the 75 code frequency is supplied to the rails of the section in the rear of section 11T.

Operation of the equipment when steady energy is supplied to a track relay by means other than the lockout circuit controlled by that relay

The system provided by this invention is arranged so that if steady energy is supplied to a track relay by any means other than the "lockout" circuit controlled by that relay, the equipment associated with that track relay will not repeat the supply of steady energy to the section in the rear. This non-cascading feature makes it unnecessary to employ special cut section facilities to prevent cascading of steady energy, while it also makes it possible to employ back contact coding where cut sections are needed, and to employ steady energy to discontinue operation of highway crossing signals or for other purposes.

For purposes of illustration it will be assumed that an insulated joint 3 separating sections 12T and 13T breaks down as a result of passage of a train, and that the equipment associated with section 13T operates as hereinbefore described in detail in connection with section 12T to establish the "lockout" circuit controlled thereby to supply steady energy to the rails of section 12T.

As explained above, when any part of the train is present in section 12T, current from transformer 12TT is shunted from the track relay 12TR, while when the train enters section 13T, the track relay for that section is shunted, and the equipment controlled thereby operates to supply energy of the 75 code frequency to the track transformer 12TT.

As soon as the train vacates section 12T, the energy of 75 code frequency supplied to the rails of section 12T, feeds to the track relay 12TR and,

unless the shunting effect of the train in advance of the defective insulated joint is too great, this energy effects code following operation of the track relay.

5 These impulses of energy of 75 code frequency supplied to the rails of section 12T will also feed over the defective joint 3 to the track relay for section 13T, but a time interval will elapse before the train will have advanced far enough in the track stretch for the energy feeding over the defective insulated joint to effect operation of the track relay for section 13T to establish the "lockout" circuit as hereinbefore described and the track relay 12TR will respond to energy of the 75 code frequency during this time interval.

10 Due to the supply of coded energy to the track relay 12TR, relay 12FSA picks up on the second picked up period of the track relay contacts, as explained above, while relays 12BSA and 12H subsequently pick up.

When the train has advanced far enough in section 13T so that the impulses of energy feeding over the defective joint 3 from section 12T cause code following operation of the track relay for section 13T, the equipment associated with that track relay will operate in the manner heretofore described in detail to establish the "lockout" circuit so that steady uncoded energy is now supplied to the rails of section 12T. On the supply of steady energy to the rails of section 12T, track relay 12TR is maintained constantly picked up and no current is induced in the secondary winding 22 of the decoding transformer 12DT, and, accordingly, current is not supplied from the winding 22 to winding 24 of relay 12FSA, while contact 17 of relay 12TR interrupts the circuit for supplying energy to relay 12BSA.

After a short time interval relay 12FSA releases and contact 47 interrupts the circuit for supplying energy of 180 code frequency to the transformer 11TT, and engages its back contact to establish the circuit through which energy of 75 code frequency is supplied to the transformer 11TT, this circuit being complete on release of contact 46 of relay 12BSA.

In addition, on release of relay 12FSA, contact 26 interrupts the circuit for supplying energy to relay 12BSA, and also interrupts the circuit connecting the snubbing resistor 28 across the terminals of the winding of relay 12BSA so that relay 12BSA quickly releases if it has not already released.

It will be observed that no energy will have been supplied to relay 12BSA from the instant at which track relay 12TR began to be steadily picked up, and hence the relay 12BSA may have released before the relay 12FSA releases.

In any case if the relay 12BSA has not become released at the time the relay 12FSA releases, the relay 12BSA will quickly release on opening of contact 26 of relay 12FSA.

On release of contact 46 of relay 12BSA the circuit for supplying energy of the 75 code frequency to the track transformer 11TT is complete, while on release of contact 30 of relay 12BSA the circuit of relay 12H is interrupted. Thereafter relay H releases after a time interval which is determined by the release time of the relay.

The relay 12H and the other parts of the equipment are designed and selected so that the operating characteristics of the various members are such that under the conditions stated the relay 12H will not release until after the relay 12FSA

releases. This sequence of operation is present even if the relay 12BSA should release substantially at, or slightly before the relay 12FSA releases and insures that the contact 35 of relay 12H will not engage its back contact to establish the circuit of the holding winding 33 of relay 12FSA until after contact 36 of relay 12FSA releases to interrupt this circuit. Accordingly there is no possibility that on the release of the relay 12H energy will be supplied to the holding winding 33 of relay 12FSA, and hence there is no possibility that the relay 12FSA will be held picked up by that winding.

At this time, as steady energy is supplied to the track relay 12TR, no current is supplied to the winding 24 of relay 12FSA and this relay remains released so that contact 26 of relay 12FSA interrupts the circuit of relay 12BSA, and contact 30 of relay 12BSA interrupts the circuit of relay 12H.

As the relay 12H is released, the red or stop lamp R of signal 12S is illuminated, while as the relays 12FSA and 12BSA are released, the circuit for supplying energy of the 75 code frequency to the track transformer 11TT is established.

From the foregoing it will be seen that when steady energy is supplied to a track relay as a result of establishment of the "lockout" circuit controlled by the track relay of the adjacent section in advance, the signal controlled by the track relay to which the steady energy is supplied will be conditioned to display its red or stop indication, but that coded energy will be supplied to the adjacent section in the rear.

As a result of this mode of operation, the signal for the section next in the rear of a defective joint will be conditioned to display its red or stop indication, but the signals for the sections farther in the rear will display proceed indications, and hence traffic in the track stretch will not be delayed unnecessarily.

The system provided by this invention is also arranged so that when steady energy is supplied to a track relay by any means other than the "lockout" circuit controlled by such track relay, or by the track relay of the adjacent section in advance, the signal controlled by the track relay to which the steady energy is supplied will be conditioned to display its stop indication, while energy of the 75 code frequency will be supplied to the rails of the adjacent section in the rear.

Steady energy may be supplied to the track relay where back contact coding is employed at a cut section in a track section. One form of apparatus for providing back contact coding at a cut section is shown in an application of Charles B. Shields and Herman G. Blosser, Serial No. 275,146, filed May 23, 1939, for Railway traffic controlling apparatus, now U. S. Patent 2,211,174, granted April 13, 1940.

Likewise steady energy may be employed in a track circuit to control a highway crossing signal, as explained in the application of Ralph R. Kemmerer, identified above.

For purposes of illustration it will be assumed that section 12T is divided into two parts, that back contact coding equipment is located at the cut section, and that the equipment at the cut section operates when the forward portion of the track section is not occupied to repeat to the rearward portion of the track section energy of the same code frequency as is supplied to the rails of the forward portion of the track section. The equipment at the cut section also operates

when the forward portion of the track section is occupied to supply steady uncoded energy to the rails of the rearward portion of the track section.

On passage of a train through the track stretch
5 the track relay 12TR is shunted when the train enters the section 12T, and the equipment associated with relay 12TR thereupon operates as described above to supply energy of the 75 code frequency to the rails of section 11T, and to condition the signal 12S to display its red or stop indication. At such times the auxiliary relays 12FSA, 12BSA and 12H are deenergized and their contacts are released.

When the train enters the forward portion of section 12T, the equipment at the cut section operates in the usual manner to discontinue the supply of coded energy to the rearward portion of the track section and to supply steady energy thereto.

20 As long as any portion of the train remains in the rearward portion of the track section the relay 12TR continues to be shunted and its contacts remain released. As soon as the train vacates the rearward portion of the track section the steady energy which is supplied to the rails thereof by the cut section apparatus feeds to the track relay 12TR and causes the relay contacts to become picked up and to thereafter remain picked up.

30 On picking up of relay 12TR an impulse of energy is supplied from the secondary winding 22 of the decoding transformer 12DT to winding 24 of relay 12FSB. As previously explained the various parts of the equipment are selected and proportioned so that on the supply of one impulse of current to the winding 24 of relay 12FSA, this relay does not pick up and hence remains released and maintains the circuit for supplying energy of the 75 code frequency to the track transformer 11TT.

40 Since at this time steady energy is supplied to the track relay 12TR, no further impulses of current are supplied to the winding 24 of relay 12FSA, and relay 12FSA remains released to maintain the circuit for supplying energy of the 75 code frequency to the track transformer 11TT, while the signal 12S continues to be conditioned to display its red or stop indication.

50 As the train proceeds through the track stretch and enters the section in advance of the forward portion of section 12T, the track relay for that section is shunted and energy of the 75 code frequency is supplied to the rails of the forward portion of section 12T so that when the train vacates that portion, the cut section facilities operate in the usual manner to repeat the supply of energy of the 75 code frequency to the rails of the rearward portion of section 12T, and thus to the track relay 12TR.

60 As a result of the supply of coded energy to the track relay 12TR, relays 12FSA, 12BSA and 12H are successively picked up, as explained above, to condition the signal 12S to display its yellow or caution indication, and to effect the supply of energy of the 180 code frequency to the track transformer 11TT.

70 From the foregoing it will be seen that the system provided by this invention is inherently non-cascading in operation so that when steady energy is supplied to a track relay by any means whatsoever other than the "lockout" circuit controlled by that relay, the signal which is controlled by the relay to which the steady energy is supplied will be conditioned to display its red or stop indication, but that coded energy will be

supplied to the adjacent section to the rear, and that the supply of steady energy will not be repeated to the rails of such adjacent section in the rear.

Operation of equipment if an insulated joint breaks down when the track stretch is vacant 5

For purposes of illustration it will be assumed that an insulated joint 3 separating sections 11T and 12T breaks down at a time when the track stretch is vacant, at which time energy of the 180 code frequency is supplied to the rails of section 12T.

At this time as relay 12TR is responding to energy of the 180 code frequency, all the auxiliary relays associated with relay 12TR are picked up and energy of the 180 code frequency is supplied to the rails of section 11T, while the signal 12S is conditioned to display its green or proceed indication.

If at the time the insulated joint separating sections 11T and 12T breaks down the impulses of energy supplied to the section 11T are out of step with those supplied to the section 12T, the impulses of energy supplied to the rails of section 11T and feeding over the defective insulated joint to the relay 12TR will fall in the "off" periods in the code supplied to section 12T with the result that track relay 12TR will be maintained picked up all or substantially all of the time.

If at the time an insulated joint separating sections 11T and 12T becomes defective the impulses of code supplied to the two sections are substantially in step with each other they will soon become out of step. This will be true because the code transmitters which create the code for the two sections are driven by electric motors of the squirrel cage induction type, and these motors will not operate at exactly the same speed for a considerable period of time. Accordingly if the track relay is not held picked up for an abnormally large proportion of the time immediately upon breaking down of the joint, the track relay will soon be held picked up an abnormally large portion of the time because of the increase in the time during which energy is supplied to the track relay winding when the two codes get out of step.

In consequence of the lengthened picked up periods of the track relay 12TR, the contact 17 of track relay 12TR will not engage its back contact, or will engage it for such short time intervals that energization of relay 12BSA is reduced below the value effective to maintain the relay picked up.

Similarly as the track relay is maintained picked up all or substantially all of the time, little or no change occurs in energization of the primary winding 20 of decoding transformer 12DT, and even though contact 16 establishes the circuit for supplying energy to the winding 24 of relay 12FSA, little or no current is supplied to this winding, and hence little or no force is available to maintain relay 12FSA picked up.

As a result of the reduced energization of relays 12FSA and 12BSA these relays become released.

On release of relay 12BSA, whether occurring before or after release of relay 12FSA, contact 30 interrupts the circuit of relay 12H, and relay 12H releases after a time interval.

As relay 12H does not release until after relay 12FSA releases, contact 35 of relay 12H does not.

engage its back contact until after contact 36 of relay 12FSA interrupts the circuit of the holding winding 33 of relay 12FSA. Accordingly, energy is not supplied to the winding 33 of relay 12FSA at this time.

On the release of relay 12H contact 42 interrupts the circuit for energizing the green lamp G of signal 12S, while it establishes a circuit to illuminate the red or stop lamp R of the signal.

On release of either of the relays 12FSA or 12BSA the circuit for supplying energy of the 180 code frequency to the rails of section 11T is interrupted, while when both relays become released the circuit for supplying energy of the 75 code frequency to the rails of section 11T is established.

The energy of 75 code frequency supplied to rails of section 11T feeds over the defective insulated joint to track relay 12TR and combines with the energy of 180 code frequency supplied by transformer 12TT. As a result of the hybrid or scrambled code supplied to the track relay 12TR the relay is picked up most of the time, but a time will quickly be reached when the relationship of the two codes is such that the contacts of the track relay are released and picked up twice in rapid succession so that two impulses of energy will be supplied to the winding 24 of relay 12FSA. As a result of such supply of energy to the relay the relay 12FSA picks up, and contact 47 establishes the "lockout" circuit for supplying steady energy to the rails of section 11T, while this steady energy feeding over the defective insulated joint maintains the track relay picked up.

In addition, on picking up of relay 12FSA, the circuit for supplying energy to the holding winding 33 of relay 12FSA is complete since track relay contact 17 is picked up, contact 35 of relay 12H is released, and contact 36 of relay 12FSA is picked up. As a result of the supply of energy to the holding winding 33 of relay 12FSA the relay is maintained picked up to thereby maintain the "lockout" circuit for supplying steady energy to the rails of section 11T so that the steady energy feeding from section 11T to the track relay 12TR will maintain the track relay picked up and thus cause the "lockout" circuit to be maintained.

The equipment shown in Fig. 1 of the drawing is arranged so that the energy which is supplied to relay 12H to pick up the relay contacts is supplied over a circuit which includes a back contact of the relay. When the relay contacts pick up this circuit is interrupted and another circuit is established to supply energy to the relay winding. While this method of operation has been found to be satisfactory, it is preferable not to require the relay to be energized in this manner, and the circuit arrangement shown in Fig. 2 has been devised to provide means to energize relay H without requiring the relay to interrupt its own energizing circuit.

In addition, in the system shown in Fig. 1 of the drawing, on entrance of a train into a track section with resultant shunting of the track relay for that section, the relay 12FSA is the first to release. Release of relay 12FSA interrupts the circuit of relay 12BSA and also interrupts the snubbing circuit for the relay with the result that relay 12BSA releases very quickly after release of relay 12FSA.

Release of relay 12BSA interrupts the circuit of relay 12H and initiates release of the contacts of this relay. However, because of the slow re-

leasing characteristic of relay 12H, a short time interval must elapse after release of relay 12BSA before relay 12H releases.

On release of the relay 12FSA the circuit for supplying energy of the 180 code frequency to the adjacent section in the rear is interrupted, while on release of the relay 12BSA the circuit for supplying energy of the 75 code frequency to the section in the rear is established. It will be seen, therefore, that in the system shown in Fig. 1 of the drawing the supply of energy of the 75 code frequency to the section in the rear is initiated before relay 12H releases.

There is a possibility that under an unusual combination of circumstances the relays 12FSA and 12BSA will pick up before the relay 12H releases, and if this occurs the circuit for supplying energy of 180 code frequency to the rails of section 11T will be established, and this energy will feed over the defective joint and produce code following operation of the track relay 12TR with the result that the circuit for supplying energy of the 180 code frequency is maintained and the green or clear lamp of signal 12S is lighted even though section 12T is occupied.

The combination of conditions which must exist before the improper supply of coded energy to the section in the rear of a defective joint can occur is such that it is extremely improbable that this supply of coded energy will occur. However, the modification shown in Fig. 2 provides means by which all possibility of the improper supply of coded energy to the rearward section may be prevented.

Construction and operation of the modification shown in Fig. 2

The equipment shown in Fig. 2 of the drawing is the same in construction and operation as that shown in Fig. 1 except as hereinafter specifically pointed out in detail. The differences between Fig. 2 and Fig. 1 relate to the means for energizing the winding of relay H, for supplying energy to the holding winding 33 of relay FSA, and to the means for controlling the circuits for supplying energy to the track circuit of the adjacent section in the rear.

As shown in the drawing, contact 17 of track relay TR when picked up engages a contact which is connected to contact 30 of relay BSA, and to contact 29 of relay H. When contact 30 of relay BSA is picked up it establishes connection to one terminal of the winding of relay H.

When contact 29 of relay H is released it engages a contact which is connected to a front contact of contact 36 of relay FSA. When contact 29 is picked up it engages a contact which is connected to terminal B of the source of current.

A further distinguishing feature of the modification shown in Fig. 2 is the circuit for supplying energy of the 75 code frequency to the adjacent section in the rear. In the system shown in Fig. 1 of the drawing this circuit is controlled by contacts of the relays FSA and BSA in such manner that the circuit is complete when the contacts of these relays are released. In the modification shown in Fig. 2 of the drawing the circuit for supplying energy of the 75 code frequency to the section in the rear is controlled not only by contacts of the relays FSA and BSA, but also by a contact 50 of the relay H so that this circuit is complete only when the contacts of all of these relays are released.

Assuming that the track stretch with which the equipment shown in Fig. 2 is associated is

vacant, and that energy of the 180 code frequency is supplied to the rails of the section with which the track relay TR is associated, the contacts of all of the auxiliary relays associated with the track relay will be picked up and energy of the 180 code frequency will be supplied to the adjacent track section in the rear.

On entrance of a train into the track section the track relay TR is shunted and after a time interval relay FSA releases. On release of relay FSA the supply of energy of the 180 code frequency is interrupted by contact 47.

On release of relay FSA contact 26 interrupts the circuit of relay BSA, while release of relay BSA interrupts the circuit of the relay H, but because of the slow releasing characteristic of the relay H, this relay does not release until after a short time interval subsequent to release of relay BSA.

Since contact 50 of relay H controls the circuit for supplying energy of 75 code frequency to the section in the rear, this circuit is not established on release of relay BSA, but is complete when relay H releases. This circuit is traced from terminal BX through back contact 46 of relay BSA, back contact 47 of relay FSA, back contact 50 of relay H, contact 75 of the code transmitter CT, and primary winding 40 of the track transformer to terminal CX.

It will be seen that on entrance of a train into a track section and shunting of the track relay that the relay FSA is the first in the series of auxiliary relays to release, and that the relay H is the last in the series of auxiliary relays to release. The modification provided by this invention is arranged so that the circuit for supplying energy of the 180 code frequency to the section in the rear is interrupted on release of the relay FSA, and that thereafter no circuit is established to supply energy to the section in the rear until relay H releases. Accordingly there is no possibility that coded energy supplied to the adjacent section in the rear will feed over a defective joint and effect picking up of the track relay prior to release of relay H with possible resultant improper establishment of the circuit for supplying energy of the 180 code frequency.

When relay H releases the circuit for supplying energy of the 75 code frequency to the section in the rear is established, and if the insulated joints separating the two sections are intact the track relay TR will continue to be deenergized following the supply of energy of the 75 code frequency to the section in the rear.

When the train advances in the track stretch far enough to vacate the section under consideration, energy of 75 code frequency is supplied to the track relay from the exit end of the section and on the supply of the second impulse of energy to relay FSA this relay picks up.

On picking up of relay FSA the circuit for supplying energy of the 75 code frequency to the rear is interrupted, while contact 47 of relay FSA establishes the "lockout" circuit for supplying steady energy to the adjacent section in the rear.

On the next or second "off" period in the code supplied to the track relay TR energy is supplied to relay BSA over the circuit which includes front contact 26 of relay FSA and relay BSA picks up so that on the next or third picked up period of the track relay contacts energy is supplied to relay H through a pick-up circuit which is traced from terminal B through front contact 26 of relay FSA, front contact 30 of relay BSA, and winding of relay H to terminal C.

On this movement of the track relay contacts to their picked up position the contacts of the relay H are still in their released position and energy is supplied to the winding 33 of relay FSA over the circuit which is traced from terminal B through front contact 17 of the track relay, back contact 29 of relay H, front contact 36 of relay FSA, and winding 33 of relay FSA to terminal C.

This circuit is interrupted as soon as contact 29 of relay H becomes disengaged from its back point of contact, but the impulse of energy supplied to winding 33 of relay FSA prior to picking up of the contacts of relay H assists in maintaining the contacts of relay FSA picked up.

On picking up of relay H contact 29 interrupts the circuit of the holding winding 33 of relay FSA, and establishes a stick circuit to maintain its own winding energized as long as relay BSA is picked up. The stick circuit for relay H is traced from terminal B through front contact 29 of relay H, front contact 30 of relay BSA and winding of relay H to terminal C.

It will be seen that both during and after picking up of relay H the circuit controlled by the track relay contact 17 for supplying energy to relay H is not interrupted, and hence the supply of energy to relay H is maintained during movement of contact 29 between its released and its picked up position.

As long as the track relay TR continues to respond to coded energy, the relays FSA, BSA and H are picked up, while energy of the 180 code frequency is supplied to the adjacent section in the rear over the circuit traced above.

Operation of the systems shown in Figs. 1 and 2 in the event the "lockout" circuit is interrupted

The systems provided by this invention are arranged so that if after the "lockout" circuit has been established it is interrupted for any reason this circuit will be automatically re-established.

For purposes of illustration it will be assumed that the equipment shown in Fig. 1 of the drawing has operated to establish the "lockout" circuit to supply steady uncoded energy to the track transformer 11T, that a train is present in section 12T, and that the supply of energy to the transformer 11T is temporarily interrupted. This interruption may occur because of temporary failure of the source of signal control current, or it may result from a loose or broken wire or from short-circuiting of the wire leading from primary winding 40 of the track transformer.

A similar condition results if the leads or wires connecting the track relay 12TR with the rails of section 12T are momentarily disconnected or short-circuited.

On interruption of the supply of energy to the track relay 12TR, whether caused by interruption of the lockout circuit or by a defect in the connection of the track relay winding with the track rails, the track relay releases, and as relay 12FSA is picked up at this time, the circuit for supplying energy to relay 12BSA is complete. If the track relay remains released for an appreciable time interval, the relay 12BSA will pick up and interrupt the "lockout" circuit so that energy will not thereafter be supplied to the transformer 11T, and therefrom to the track relay even if the original cause for interruption of the supply of current to the relay winding no longer exists.

It is to be observed that under the conditions

stated, that is, the track relay 12TR released, the relays 12FSA and 12BSA picked up, and the relay 12H released, the circuit for supplying energy of the 75 code frequency to the transformer 11TT is interrupted, and the circuit for supplying energy of the 180 code frequency to the transformer 11TT is also interrupted. Since the "lockout" circuit is interrupted at this time all sources of supply of energy to the transformer 11TT are interrupted, and hence no energy is supplied thereto, while energy will not feed over the defective joint from the rails of section 11T to the track relay 12TR.

Accordingly, the track relay 12TR remains released and energy is not supplied to relay 12H even though the contact 30 of relay 12BSA is picked up. As the relay H remains deenergized it continues to condition the signal 12S to display its stop indication.

In addition as the track relay 12TR is released energy is not supplied to the holding winding 33 of relay 12FSA, and, after a brief time interval, the relay 12FSA releases and contact 26 interrupts the circuit of relay 12BSA, and also interrupts the circuit of the snubbing resistor 28 so that relay 12BSA thereafter quickly releases.

When the relays 12FSA and 12BSA are released the circuit for supplying energy of the 75 code frequency to the rails of section 11T is established, and this energy feeding over the defective joint to the track relay 12TR produces code following operation of that relay, assuming that the fault in the system has been corrected. On the second picked up period of the track relay contacts, relay 12FSA picks up, thereby reestablishing the "lockout" circuit, while energy is again supplied to the holding winding 33 of relay 12FSA to maintain the relay contacts picked up.

From the foregoing it will be seen that the system shown in Fig. 1 operates in the event of temporary interruption of the "lockout" circuit, or similar conditions, to reestablish the "lockout" circuit and to maintain the signal displaying its red or stop indication.

The system shown in Fig. 2 operates in a manner similar to that shown in Fig. 1 on interruption of the "lockout" circuit, or of the circuit of the track relay winding.

From the foregoing it will be seen that we have provided an improved signaling system which operates to establish a "lockout" or steady energy supply circuit in the event an insulated joint is defective, and that the system is inherently non-cascading in operation so that special facilities to prevent cascading of steady energy are not required.

It will be seen also that this system requires less equipment than previous systems providing the same operating results.

Although we have herein shown and described only two forms of railway signaling system embodying our 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 our invention.

Having thus described our invention, what we claim is:

1. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having

a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer to thereby cause impulses of energy to be induced in said transformer secondary winding, a first, a second and a third auxiliary relay, a circuit including a front contact of said track relay for supplying energy from said transformer secondary winding to a winding of said first auxiliary relay, said transformer and said first auxiliary relay being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied in rapid succession from the transformer secondary winding to the relay winding and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit including a front contact of the second auxiliary relay for supplying energy to the winding of the third auxiliary relay, a circuit including front contacts of the track relay and of the first auxiliary relay and a back contact of the third auxiliary relay for supplying energy to a winding of the first auxiliary relay, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, a circuit including a front contact of the first auxiliary relay and a back contact of the second auxiliary relay over which steady energy may be supplied to the rails of said rearward section, and a circuit including a front contact of said third auxiliary relay for supplying coded energy to the rails of said rearward section.

2. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer to thereby cause impulses of energy to be induced in said transformer secondary winding, a first, a second and a third auxiliary relay, a circuit including a front contact of said track relay for supplying energy from said transformer secondary winding to a winding of said first auxiliary relay, said transformer and said first auxiliary relay being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied in rapid succession from the transformer secondary winding to the relay winding and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit including a front contact of the second auxiliary relay for supplying energy to the winding of the third auxiliary relay, a circuit including front contacts of the track relay and of the first auxiliary

relay and a back contact of the third auxiliary relay for supplying energy to a winding of the first auxiliary relay, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, a circuit including a front contact of the first auxiliary relay and a back contact of one of the other auxiliary relays over which steady energy may be supplied to the rails of said rearward section, and a circuit including a front contact of said third auxiliary relay for supplying coded energy to the rails of said rearward section.

3. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer to thereby cause impulses of energy to be induced in said transformer secondary winding, a first, a second and a third auxiliary relay, a circuit including a front contact of said track relay for supplying energy from said transformer secondary winding to a winding of said first auxiliary relay, said transformer and said first auxiliary relay being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied in rapid succession from the transformer secondary winding to the relay winding and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit including a front contact of the second auxiliary relay for supplying energy to the winding of the third auxiliary relay, a circuit including front contacts of the track relay and of the first auxiliary relay and a back contact of the third auxiliary relay for supplying energy to a winding of the first auxiliary relay, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, a circuit including a front contact of the first auxiliary relay and a back contact of one of the other auxiliary relays over which steady energy may be supplied to the rails of said rearward section, and a circuit including front contacts of said first auxiliary relay and of one of the other auxiliary relays for supplying coded energy to the rails of said rearward section.

4. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer to thereby cause impulses of energy to be induced in said

transformer secondary winding, a first, a second and a third auxiliary relay, said first auxiliary relay being provided with a plurality of windings and including a pick-up and a holding winding, a circuit including a back contact of said first auxiliary relay for shunting said holding winding to thereby render the relay contacts slow to pick up, a circuit including a front contact of the track relay for supplying energy from said transformer secondary winding to the pick-up winding of said first auxiliary relay, said first auxiliary relay and said transformer being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied in rapid succession from the transformer secondary winding to said relay pick-up winding and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit including a front contact of the second auxiliary relay for supplying energy to the winding of the third auxiliary relay, a circuit including front contacts of the track relay and of the first auxiliary relay and a back contact of the third auxiliary relay for supplying energy to the holding winding of the first auxiliary relay, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, a circuit including a front contact of the first auxiliary relay and a back contact of one of the other auxiliary relays over which steady energy may be supplied to the rails of said rearward section, and a circuit including a front contact of one of said other auxiliary relays for supplying coded energy to the rails of said rearward section.

5. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer to thereby cause impulses of energy to be induced in said transformer secondary winding, a first, a second and a third auxiliary relay, said first auxiliary relay being provided with a plurality of windings and including a pick-up and a holding winding, a circuit including a front contact of the track relay for supplying energy from said transformer secondary winding to the pick-up winding of said first auxiliary relay, said first auxiliary relay and said transformer being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied in rapid succession from the transformer secondary winding to said relay pick-up winding and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit including a front contact of the second auxiliary relay for supply-

ing energy to the winding of the third auxiliary relay, a circuit including front contacts of the track relay and of the first auxiliary relay and a back contact of the third auxiliary relay for supplying energy to the holding winding of the first auxiliary relay, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, means operative on picking up of the contacts of the first auxiliary relay at a time when the contacts of a predetermined one of the other auxiliary relays are released to establish a circuit over which steady energy may be supplied to the rails of said rearward section, means operative on picking up of the contacts of said other auxiliary relay to interrupt said steady energy supply circuit, and means operative on continued code following operation of said track relay subsequent to establishment of said steady energy supply circuit to supply coded energy to the rails of said rearward section.

6. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer primary winding to thereby cause impulses of energy to be induced in said transformer secondary winding, a first, a second and a third auxiliary relay, a circuit including a front contact of said track relay for supplying energy from said transformer secondary winding to a winding of said first auxiliary relay, said first auxiliary relay and said transformer being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied in rapid succession from the transformer secondary winding to the relay winding and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit including front contacts of the track relay and of the second auxiliary relay for supplying energy to the winding of the third auxiliary relay, a circuit including front contacts of the track relay and of the first auxiliary relay and a back contact of the third auxiliary relay for supplying energy to a winding of the first auxiliary relay, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, means operative on picking up of the contacts of the first auxiliary relay at a time when the contacts of a particular one of the other auxiliary relays are released to establish a circuit over which steady energy may be supplied to the rails of said rearward section, means operative on picking up of the contacts of said other auxiliary relay to interrupt said steady energy supply circuit, and means responsive to code following operation of said track relay subsequent to establishment of said steady energy supply circuit for supplying coded energy to the rails of said rearward section.

7. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer to thereby cause impulses of energy to be induced in said transformer secondary winding, a first, a second and a third auxiliary relay, said first auxiliary relay being provided with a plurality of windings including a pick-up and a holding winding, a circuit including a contact of the track relay for supplying energy from said transformer secondary winding to the pick-up winding of said first auxiliary relay, said first auxiliary relay and said transformer being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied to the relay pick-up winding in rapid succession and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit for supplying energy to the winding of the second auxiliary relay when the contacts of the track relay are released and the contacts of the first auxiliary relay are picked up, a circuit

for supplying energy to the winding of the third auxiliary relay, a circuit including front contacts of the track relay and of the first auxiliary relay and a back contact of the third auxiliary relay for supplying energy to the holding winding of the first auxiliary relay, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, means operative on picking up of the contacts of the first auxiliary relay at a time when the contacts of a predetermined one of the other auxiliary relays are released to establish a circuit over which steady energy may be supplied to the rails of said rearward section, means operative on picking up of the contacts of said other auxiliary relay to interrupt said steady energy supply circuit, and means operative on continued code following operation of said track relay subsequent to establishment of said steady energy supply circuit to supply coded energy to the rails of said rearward section.

8. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a transformer, means responsive to code following operation of the track relay contacts for varying energization of the primary winding of said transformer to thereby cause impulses of energy to be induced in said transformer secondary winding, a first, a second and a third auxiliary relay, said first auxiliary relay being provided with a plurality of windings including a pick-up and a holding winding, a circuit including a contact of the track relay for supplying energy from said transformer secondary winding to the pick-up winding of said first auxiliary relay, said first auxiliary relay and said transformer being selected and proportioned so that the relay contacts when released become picked up only after a plurality of impulses of energy are supplied to the relay pick-up winding in rapid succession and so that the relay contacts thereafter remain picked up as long as the track relay continues to respond to coded energy, a circuit for supplying energy to the winding of the second auxiliary relay when the contacts of the track relay are released and the contacts of the first auxiliary relay are picked up, a circuit

for supplying energy to the winding of the third auxiliary relay when the contacts of the track relay and of the second auxiliary relay are picked up, a circuit for also supplying energy to the winding of the third auxiliary relay when the contacts of said third auxiliary relay and of the second auxiliary relay are picked up, a circuit for supplying energy to the holding winding of the first auxiliary relay when the contacts of the track relay and of the first auxiliary relay are picked up and the contacts of the third auxiliary relay are released, means operative when the track relay is shunted to supply coded energy to the rails of said rearward section, means operative when the contacts of the first auxiliary relay are picked up and the contacts of a particular one of the other auxiliary relays are released to establish a circuit over which steady energy may be supplied to the rails of said rearward section, and means responsive to continued code following operation of said track relay subsequent to picking up of the contacts of the first auxiliary relay for interrupting said steady energy supply circuit and for affecting the supply of coded energy to said rearward section.

9. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for supplying coded energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a first, a second and a third auxiliary relay associated with said track relay, a circuit including a front contact of the track relay for supplying energy to a winding of the first auxiliary relay, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit complete when the contacts of the track relay and of the second auxiliary relay are picked up for supplying energy to the winding of the third auxiliary relay, a circuit complete when the contacts of the first auxiliary relay are picked up and the contacts of the second auxiliary relay are released over which steady uncoded energy may be supplied to the rails of the rearward section, and a circuit complete when the contacts of the third auxiliary relay are picked up for supplying coded energy to the rails of said rearward section, the third auxiliary relay having a slow pick-up characteristic whereby the contacts of said relay do not become picked up until after the contacts of the second auxiliary relay become released unless the contacts of the second auxiliary relay remain picked up for a period longer than they do remain picked up when said second auxiliary relay is energized by current supplied during a momentary release of the track relay contacts which is of such duration that the track relay contacts become picked up again by current supplied over the circuit including a back contact of said second auxiliary relay.

10. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for supplying coded energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a first, a second and a third auxiliary relay associated with said track relay,

a circuit including a front contact of the track relay for supplying energy to a winding of the first auxiliary relay, a circuit including a back contact of the track relay and a front contact of the first auxiliary relay for supplying energy to the winding of the second auxiliary relay, a circuit complete when the contacts of the track relay and of the second auxiliary relay are picked up for supplying energy to the winding of the third auxiliary relay, a circuit for also supplying energy to the winding of the third auxiliary relay, said circuit being complete when the contacts of the second and third auxiliary relays are picked up, a circuit complete when the contacts of the first auxiliary relay are picked up and the contacts of the second auxiliary relay are released over which steady uncoded energy may be supplied to the rails of the rearward section, and a circuit complete when the contacts of the second and third auxiliary relays are picked up for supplying coded energy to the rails of said rearward section, the third auxiliary relay having a slow pick-up characteristic whereby the contacts of said relay do not become picked up until after the contacts of the second auxiliary relay become released unless the contacts of the second auxiliary relay remain picked up for a period longer than they do remain picked up when said second auxiliary relay is energized by current supplied during a momentary release of the track relay contacts which is of such duration that the track relay contacts become picked up again by current supplied over the circuit including the back contact of said second auxiliary relay.

11. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a first, a second, and a third auxiliary relay associated with said track relay, means responsive to and operative on code following operation of the track relay contacts to supply energy to a winding of the first auxiliary relay to pick the relay contacts up and to maintain them picked up, a circuit complete when the track relay contacts are released and the contacts of the first auxiliary relay are picked up to supply energy to the winding of the second auxiliary relay, a source of current, a supply conductor, means operative when the track relay contacts are picked up to establish connection from one terminal of said source of current to said supply conductor, means operative when the contacts of said third auxiliary relay are picked up to also establish connection from said one terminal of the source of current to said supply conductor, means operative when the contacts of the second auxiliary relay are picked up to establish connection from said supply conductor to the winding of the third auxiliary relay, a circuit including a front contact of the first auxiliary relay through which connection may be established from said supply conductor to a winding of said first auxiliary relay to maintain the contacts of said first auxiliary relay picked up, said circuit also including a back contact of the third auxiliary relay whereby on picking up of the contacts of said third auxiliary relay connection from said supply conductor to the winding of the first auxiliary relay is interrupted to thereby eliminate interference by the

first auxiliary relay winding with the release time of the third auxiliary relay, the third auxiliary relay having a slow releasing characteristic whereby on cessation of code following operation of the track relay contacts the contacts of the third auxiliary relay do not become released until after the contacts of the first auxiliary relay become released, a circuit complete when the contacts of the first auxiliary relay are picked up and the contacts of the second auxiliary relay are released over which steady energy may be supplied to the rails of said rearward section, and a circuit complete when the contacts of the first and second auxiliary relays are released for supplying coded energy to the rails of said rearward section.

12. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, said track relay having contacts which occupy a released position when the relay winding is not energized and which are moved to a picked up position when the relay winding is energized, an auxiliary relay associated with said track relay, means responsive to code following operation of the track relay contacts and operative on movement of the track relay contacts to their picked up position to supply to a winding of said auxiliary relay an impulse of energy of a value such that the auxiliary relay contacts when released become picked up only after a plurality of such impulses of energy have been supplied to the relay winding in rapid succession, the value of said impulses also being such that the auxiliary relay contacts when picked up will be maintained picked up as long as the track relay contacts continue to respond to coded energy, means for supplying coded energy to the rails of said rearward section, means operative on picking up of the contacts of said auxiliary relay to establish a circuit over which steady energy may be supplied to the rails of said rearward section, and means responsive to and operative on continued code following operation of the track relay contacts subsequent to establishment of said steady energy supply circuit to interrupt said steady energy supply circuit and to effect the supply of coded energy to the rails of said rearward section.

13. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, said track relay having contacts which occupy a released position when the relay winding is not energized and which are moved to a picked up position when the relay winding is energized, an auxiliary relay associated with said track relay, means responsive to code following operation of the track relay contacts and operative on movement of the track relay contacts to their picked up position to supply to a winding of said auxiliary relay impulses of energy of a value such that the auxiliary re-

lay contacts when released become picked up only after a plurality of said impulses of energy have been supplied to the relay winding in rapid succession, the value of said impulses also being such that the auxiliary relay contacts when picked up will be maintained picked up as long as the track relay contacts continue to respond to coded energy, means for supplying coded energy to the rails of said rearward section, means operative on picking up of the contacts of said auxiliary relay to establish a circuit over which steady energy may be supplied to the rails of said rearward section, means responsive to and operative on continued code following operation of the track relay contacts subsequent to establishment of said steady energy supply circuit to interrupt the supply of coded energy to the rails of said rearward section, a signal governing movement of traffic in said forward section, said signal being capable of displaying a plurality of different indications and being conditioned to display its most restrictive indication when said track relay is not responding to coded energy, and means responsive to code following operation of said track relay for conditioning said signal to display one of its less restrictive indications.

14. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, said track relay having contacts which occupy a released position when the relay winding is not energized and which are moved to a picked up position when the relay winding is energized, a first, a second, and a third auxiliary relay associated with said track relay, means responsive to code following operation of the track relay contacts and operative on movement of the track relay contacts to their picked up position to supply to a winding of the first auxiliary relay impulses of energy of a value such that the auxiliary relay contacts when released become picked up when and only when a plurality of said impulses of energy are supplied to said relay winding in rapid succession, the value of said impulses also being such that the auxiliary relay contacts when picked up will be maintained picked up as long as the track relay contacts continue to respond to coded energy, means operative when the contacts of the track relay and of the first auxiliary relay are picked up and the contacts of the third auxiliary relay are released to supply energy to a winding of the first auxiliary relay to maintain the contacts of said first auxiliary relay picked up, means operative when the track relay contacts are released and the first auxiliary relay contacts are picked up for supplying energy to the winding of the second auxiliary relay, means operative when the contacts of the second auxiliary relay are picked up to supply energy to the winding of the third auxiliary relay, means for supplying coded energy to the rails of said rearward section, a circuit complete when the contacts of the first auxiliary relay are picked up and the contacts of the second auxiliary relay are released over which steady energy may be supplied to the rails of said rearward section, and a circuit for supplying coded

energy to the rails of said rearward section, said last-named circuit being complete only when the contacts of one of the auxiliary relays other than the first auxiliary relay are picked up, whereby said last-named circuit is established only if code following operation of the track relay continues after establishment of the circuit for supplying steady energy to the rails of said rearward section.

15. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, said track relay having contacts which occupy a released position when the relay winding is not energized and which are moved to a picked up position when the relay winding is energized, a first, a second, and a third auxiliary relay associated with said track relay, means responsive to code following operation of the track relay contacts and operative on movement of the track relay contacts to their picked up position to supply to a winding of the first auxiliary relay impulses of energy of a value such that the auxiliary relay contacts when released become picked up when and only when a plurality of said impulses of energy are supplied to said relay winding in rapid succession, the value of said impulses also being such that the auxiliary relay contacts when picked up will be maintained picked up as long as the track relay contacts continue to respond to coded energy, means operative when the contacts of the track relay and of the first auxiliary relay are picked up and the contacts of the third auxiliary relay are released to supply energy to a winding of the first auxiliary relay to maintain the contacts of said first auxiliary relay picked up, means operative when the track relay contacts are released and the first auxiliary relay contacts are picked up for supplying energy to the winding of the second auxiliary relay, means operative when the contacts of the track relay and of the second auxiliary relay are picked up to supply energy to the winding of the third auxiliary relay, whereby on cessation of code following operation of the track relay contacts the supply of energy to the winding of the third auxiliary relay is not interrupted until the contacts of the second auxiliary relay become released, means for supplying coded energy to the rails of said rearward section, a circuit complete when the contacts of the first auxiliary relay are picked up and the contacts of the second auxiliary relay are released over which steady energy may be supplied to the rails of said rearward section, and a circuit for supplying coded energy to the rails of said rearward section, said last-named circuit being complete only when the contacts of one of the auxiliary relays other than the first auxiliary relay are picked up, whereby said last-named circuit is established only if code following operation of the track relay contacts continues after establishment of the circuit for supplying steady energy to the rails of said rearward section.

16. In a coded railway signaling system, in

combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, said track relay having contacts which occupy a released position when the relay winding is not energized and which are moved to a picked up position when the relay winding is energized, a first, a second and a third auxiliary relay associated with said track relay, the first auxiliary relay being provided with a plurality of windings, a circuit complete when and only when the contacts of the first auxiliary relay are released to short circuit one winding of said first auxiliary relay to thereby render the relay contacts slow to pick up, means responsive to code following operation of the track relay contacts and operative on movement of the track relay contacts to their picked up position to supply to another winding of said first auxiliary relay impulses of energy of a value such that the auxiliary relay contacts when released become picked up when and only when a plurality of said impulses of energy are supplied to said relay winding in rapid succession, the value of said impulses also being such that the auxiliary relay contacts when picked up will be maintained picked up as long as the track relay contacts continue to respond to coded energy, means operative when the contacts of the track relay and of the first auxiliary relay are picked up and the contacts of the third auxiliary relay are released to supply energy to a winding of the first auxiliary relay to maintain the contacts of said first auxiliary relay picked up, means operative when the contacts of the track relay are released and the contacts of the first auxiliary relay are picked up to supply energy to the winding of the second auxiliary relay, means operative when the contacts of the second auxiliary relay are picked up to supply energy to the winding of the third auxiliary relay, a first supply circuit for supplying coded energy to the rails of said rearward section, said first supply circuit being effective to control the supply of energy to said rearward section when the contacts of the first auxiliary relay are released, a second supply circuit complete when and only when the first auxiliary relay contacts are picked up and the contacts of the second auxiliary relay are released over which steady energy may be supplied to the rails of said rearward section, and a third supply circuit for supplying coded energy to the rails of said rearward section, said third supply circuit being established on picking up of the contacts of one of the auxiliary relays other than the first auxiliary relay.

17. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, said track relay having contacts which occupy a released position when the relay winding is not energized and which are moved to a picked up position when the relay winding is energized, a first, a second and a third auxiliary relay associated with said track relay, means responsive to code following operation of the

track relay contacts and operative on movement of the track relay contacts to their picked up position to supply to a winding of the first auxiliary relay impulses of energy of a value such that the contacts of said auxiliary relay when released become picked up when and only when a plurality of said impulses of energy are supplied to said relay winding in rapid succession, the value of said impulses also being such that said auxiliary relay contacts when picked up will be maintained picked up as long as the track relay contacts continue to respond to coded energy, a holding circuit complete when the contacts of the track relay and the first auxiliary relay are picked up and the contacts of the third auxiliary relay are released to supply energy to a winding of the first auxiliary relay to maintain the contacts of said relay picked up, means operative when the contacts of the track relay are released and the contacts of the first auxiliary relay are picked up to supply energy to the winding of the second auxiliary relay, means operative when the contacts of the track relay and of the second auxiliary relay are picked up to supply energy to the winding of the third auxiliary relay, the first and third auxiliary relays being selected so that their release times are such that on cessation of code following operation of the track relay contacts the contacts of the first auxiliary relay become released before the contacts of the third auxiliary relay become released, whereby the holding circuit for supplying energy to a winding of the first auxiliary relay is interrupted by a contact of the first auxiliary relay before said holding circuit can be completed by a contact of the third auxiliary relay, a first supply circuit for supplying coded energy to the rails of said rearward section, said first supply circuit being effective to control the supply of energy to said rearward section when the contacts of said first auxiliary relay are released, a second supply circuit complete when and only when the first auxiliary relay contacts are picked up and the second auxiliary relay contacts are released over which steady energy may be supplied to the rails of said rearward section, and a third supply circuit for supplying coded energy to the rails of said rearward section, said third supply circuit being established on picking up of the contacts of one of the auxiliary relays other than the first auxiliary relay.

18. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy and at other times supplying steady energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, said track relay having contacts which occupy a released position when the relay winding is not energized and which are moved to a picked up position when the relay winding is energized, a first, a second and a third auxiliary relay associated with said track relay, means responsive to code following operation of the track relay contacts and operative on movement of the track relay contacts to their picked up position to supply to a winding of the first auxiliary relay impulses of energy of a value such that the contacts of said auxiliary relay when released become picked up when and only when a plurality of said impulses of energy are supplied to said relay winding in

rapid succession, the value of said impulses also being such that said auxiliary relay contacts when picked up will be maintained picked up as long as the track relay contacts continue to respond to coded energy, means operative when the track relay contacts are released and the contacts of the first auxiliary relay are picked up to supply energy to the winding of the second auxiliary relay, means operative when the contacts of the track relay and of the second auxiliary relay are picked up to supply energy to the winding of the third auxiliary relay, a first supply circuit for supplying coded energy to the rails of said rearward section, said first supply circuit being effective to control the supply of energy to said rearward section when the contacts of said first auxiliary relay are released, a second supply circuit over which steady energy may be supplied to the rails of said rearward section, said second supply circuit being complete when and only when the contacts of the first auxiliary relay are picked up and the contacts of one of the auxiliary relays other than the first auxiliary relay are released, whereby said second supply circuit is established on initiation of code following operation of the track relay contacts and is interrupted on continued code following operation of the track relay contacts subsequent to establishment of said second supply circuit, and a third supply circuit for supplying coded energy to the rails of said rearward section, said third supply circuit being established on picking up of the contacts of one of the auxiliary relays other than the first auxiliary relay.

19. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a first, a second and a third auxiliary relay, a circuit including a front contact of the track relay for supplying energy to the winding of the first auxiliary relay, a circuit including a back contact of the track relay for supplying energy to the winding of the second auxiliary relay, a circuit including a front contact of the second auxiliary relay for supplying energy to the winding of the third auxiliary relay, a circuit for supplying coded energy to the rails of said rearward section, said circuit including a back contact of said third auxiliary relay to thereby prevent the supply of energy to said rearward section through said circuit on shunting of the track relay until the contacts of said third auxiliary relay become released, a circuit including a front contact of the first auxiliary relay and a back contact of one of the other auxiliary relays over which steady energy may be supplied to the rails of said rearward section, and a circuit including a front contact of the third auxiliary relay for supplying coded energy to the rails of said rearward section.

20. In a coded railway signaling system, in combination, a stretch of railway track having a pair of track rails divided by insulated joints into a plurality of successive track sections including a forward and a rearward section, means for at times supplying coded energy to the rails of said forward section, a code following track relay having a winding receiving energy from the rails of said forward section, a first, a second and a third auxiliary relay, a circuit includ-

ing a front contact of the track relay for supply-
ing energy to the winding of the first auxiliary
relay, a circuit including a back contact of the
track relay for supplying energy to the winding
5 of the second auxiliary relay, a circuit includ-
ing a front contact of the second auxiliary relay
for supplying energy to the winding of the third
auxiliary relay, a circuit for supplying coded en-
ergy to the rails of said rearward section, said
10 circuit including a back contact of each of said
auxiliary relays to thereby prevent the supply
of energy to said rearward section through said

circuit on shunting of the track relay until the
contacts of all three auxiliary relays become re-
leased, a circuit including a front contact of the
first auxiliary relay and a back contact of one
of the other auxiliary relays over which steady 5
energy may be supplied to the rails of said rear-
ward section, and a circuit including front con-
tacts of the third auxiliary relay and of one of
the other of said auxiliary relays for supplying
coded energy to the rails of said rearward section. 10

LESLIE R. ALLISON.

FRANK H. NICHOLSON.