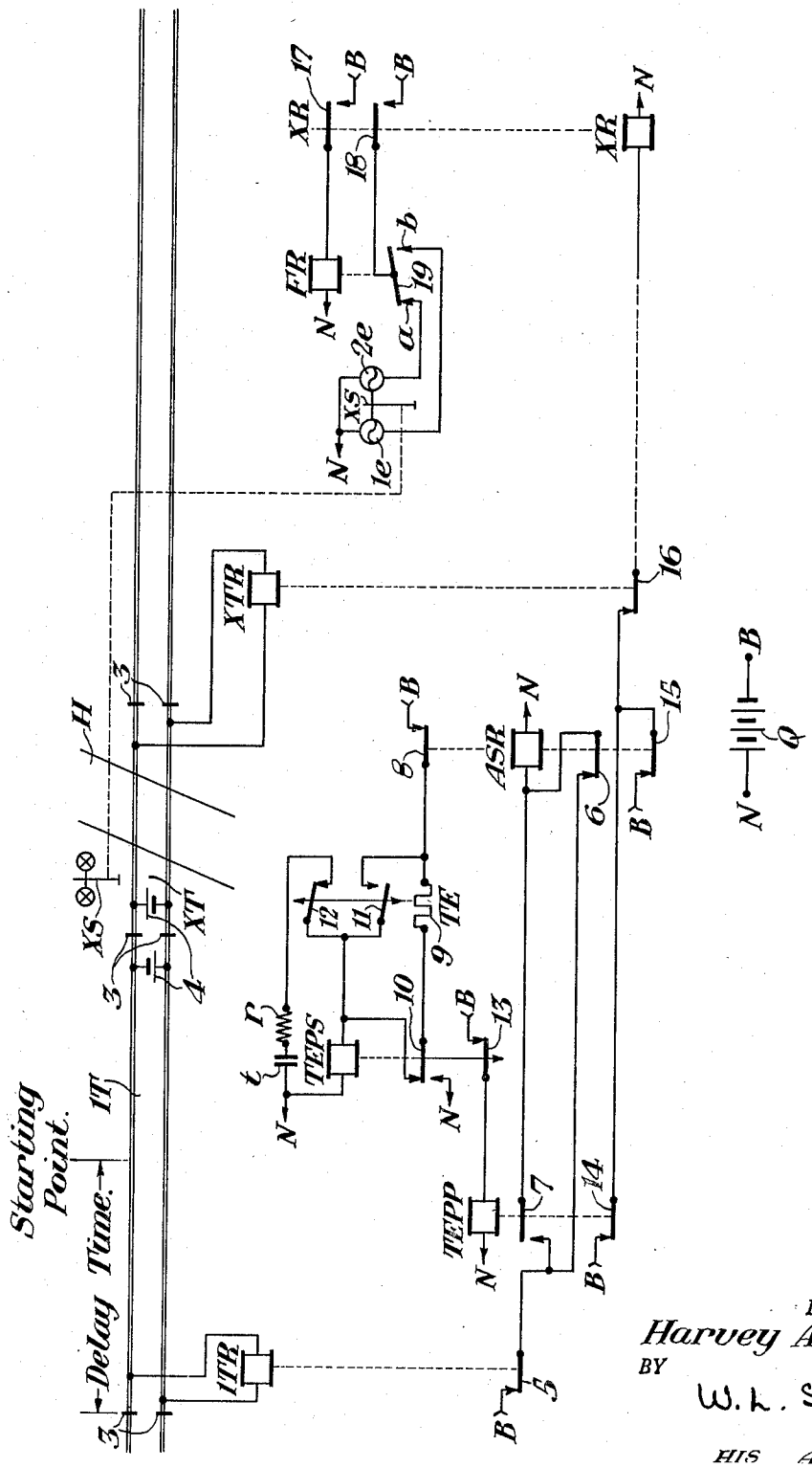
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APPARATUS FOR CONTROLLING HIGHWAY CROSSING SIGNALS

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APPARATUS FOR CONTROLLING HIGHWAY CROSSING SIGNALS

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My invention relates to apparatus for controlling highway crossing signals, and particularly to apparatus for protecting against momentary losses of track circuit shunt in highway crossing signal control systems which embody a capacitor for delaying the starting of the operation of the highway crossing signal after a train approaches within a given distance of the intersection of a highway with a railway track.

It is important that a highway crossing signal be operated long enough before the arrival of a train at an intersection of a highway with a railway track, to provide ample warning to users of the highway that a train is approaching, so that users of the highway will have sufficient time to get into the clear. It is, however, desirable that a highway crossing signal be not operated so long before the arrival of a train at the intersection as to unduly delay users of the highway and thereby cause them to become careless about obeying indications given by highway crossing signals.

It is well-known practice to install insulated joints for dividing a railway track into approach and crossing track sections adjacent the intersection of a highway with the railway track, for starting the operation of a highway crossing signal in response to the arrival of a train within a given distance from the highway crossing, and for continuing operation of the highway crossing signal while the train is moving over the crossing. If train movements are in both directions over the track, an approach section is provided in each direction from the intersection. Operation of a highway crossing signal is started when a train approaching the intersection enters the corresponding approach section, and is continued until the train vacates the crossing track section.

From the standpoint of maintenance costs of insulated joints, as well as of the original cost of installing them, it is desirable to keep from dividing a railway track into any more sections than can be avoided. If, for some other purpose, such, for example, as the control of a railway signal, insulated joints are already installed in a railway track in the vicinity of an intersection of a highway with the railway track, but at a location which is farther from the intersection or crossing than is necessary for providing ample warning to users of the highway when a train is approaching the crossing, a capacitor-resistor arrangement can be used for delaying starting of the operation of a highway crossing signal for a desired period of time after

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the leading end of a train approaching the intersection has passed over those insulated joints.

It has been found, however, that in a highway crossing signal control system in which a capacitor-resistor arrangement is employed for delaying the starting of operation of a highway crossing signal when a train enters an approach control track section, there may be a dangerous condition if there should be a momentary loss of track circuit shunt of the approach track section. This is because the capacitor, in the capacitor-resistor arrangement, may become recharged because of a momentary loss of track circuit shunt, and delay still further the starting of the operation of the highway crossing signal. If the momentary loss of shunt of the track circuit for an approach track section should occur near the end of the delay period normally provided by the capacitor-resistor arrangement, the resulting delay period might be almost double the normal delay period intended, so that the highway crossing signal would provide very little, if any, warning of the approach of a train before the train arrived on the crossing track section.

An object of my invention is therefore the provision of means for protecting against a momentary loss of shunt of a track circuit for an approach control section in a highway signal control system in which a capacitor-resistor arrangement is used for delaying the starting of operation of the highway crossing signal after a train enters the approach control section.

A feature of my invention, for accomplishing this object, is the provision of time element means for effecting energization of a control stick relay only upon the lapse of a measured period of time if the track relay for an approach control section becomes energized because of a momentary loss of track circuit shunt while a train is on the approach control section, or because the train has left the approach control section, and for effecting the charging of a capacitor only upon the lapse of a further measured period of time after the control stick relay has become energized.

Another feature of my invention, in an arrangement for protecting against a momentary loss of track circuit shunt of an approach control track section in a highway crossing signal control system, is the provision of means for discontinuing operation of the highway crossing signal as soon as a train vacates the crossing track section.

I shall describe one form of apparatus embody-

ing my invention, and shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing one form of apparatus embodying my invention, in which a railway track which is intersected by a highway is divided to form a crossing section at the highway and an approach control section adjacent one end of the crossing section; in which an approach stick relay, designated by the reference character ASR, may become operated immediately in the event of a momentary loss of track circuit shunt of an approach control section which is occupied by a train, or when the train vacates the approach control section; in which a time element device, designated by the reference character TE, effects energization of a control stick relay, designated by the reference character TEPS, upon the lapse of a measured period of time after relay ASR becomes operated; and in which the time element device TE then effects charging of an energy storing device such, for example, as a capacitor, designated by the reference character *t*, only upon the lapse of a further measured period of time after relay TEPS has become energized.

Similar reference characters refer to similar parts in the drawing.

Referring further to the drawing, a stretch of railway track is shown intersected by a highway designated by the reference character H. A highway crossing signal, designated by the reference character XS, which may be of any suitable design, but which, as shown in the drawing, is of the flashing light type, is located adjacent the intersection of the highway H with the railway track. I shall assume that train movements over the stretch of track from left to right, as shown in the drawing, are in the eastbound direction, and therefore traffic movements from right to left, as shown in the drawing, are in the westbound direction.

The rails of the railway track are divided by insulated joints 3 to form a crossing section, designated by the reference character XT, at the intersection of the highway with the railway track, and an eastbound approach control track section, designated by the reference character 1T, adjacent the west end of section XT.

Each of the track sections XT and 1T is provided with a track circuit which includes a relay XTR or 1TR, respectively, connected across the rails adjacent one end of the section, and a suitable source of current, such as a battery 4, connected across the rails adjacent the opposite end of the section.

The approach stick relay ASR has a pickup and a stick circuit, both of which are controlled by a front contact 5 of the approach section track relay 1TR, and the pickup circuit is also controlled by a back contact 7 of a repeater relay, designated by the reference character TEPP, for the control stick relay TEPS.

Time element device TE may be of the thermal type, provided with a control element, designated by the reference character 9, and having a slow pickup front contact 11 which becomes closed when the control element 9 has been energized for a measured period of time, and also having a slow closing back contact 12 which becomes closed upon the lapse of a further measured period of time after the control element 9 has become deenergized. An energizing circuit for time element device TE is at times completed through a front contact 8 of relay ASR and the back point of a contact 10 of relay TEPS.

Both a pickup and a stick circuit for relay TEPS are controlled by contact 8 of relay ASR. The pickup circuit for relay TEPS also includes contact 11 of time element device TE, and the stick circuit includes control element 9 of time element device TE.

The capacitor *t* is in series with a resistor, designated by the reference character *r*, and with the back contact 12 of time element device TE, in a circuit path which is in multiple with the winding of relay TEPS in the stick circuit for this relay. Relay TEPS is rendered slow releasing by capacitor *t* and resistor *r* in this path in multiple with its control winding when relay ASR becomes deenergized and its contact 8 becomes opened.

A crossing signal control relay, designated by the reference character XR, is controlled by front contacts of relays TEPP, ASR and XTR, and may also be controlled by contacts of directional stick relays which are not a part of my invention and are therefore not shown in the drawing. Relay XR is normally energized.

A flasher control relay, designated by the reference character FR, is controlled by a back contact 17 of relay XR, and is therefore normally deenergized. Relay FR is of a well-known type having a movable contact element 19 which, while relay FR is energized, oscillates between a first position in which it engages a first fixed contact element *a* and a second position in which it engages a second fixed contact element *b*.

As shown in the drawing, highway crossing signal XS embodies two lamps, designated by the reference characters 1*e* and 2*e*, the lighting circuits for which include contacts 19–*b* and 18–*a*, respectively, of relay FR, and a back contact 18 of relay XR. Lamps 1*e* and 2*e* are therefore normally not lighted. When relay XR becomes deenergized, causing its contact 17 to become closed in the circuit for energizing relay FR, and causing its contact 18 to become closed in the lighting circuits for signal XS, lamps 1*e* and 2*e* of signal XS will display a flashing indication on account of being repeatedly lighted alternately through the contacts 19–*b* and 19–*a* of relay FR.

The control and lighting circuits shown in the drawing may be supplied with energy from any suitable source such, for example, as a battery, designated by the reference character Q, having terminals B and N.

Having described, in general, the arrangement and control of the apparatus shown by the accompanying drawing, I shall now describe, in detail, its operation.

As shown in the drawing, all parts of the apparatus are in their normal condition, that is, each of the track sections is unoccupied, and therefore the track relays XTR and 1TR are energized; relays TEPS, TEPP, ASR and XR are energized; capacitor *t* is in the charged condition; control element 9 of time element TE is in series with the winding of relay TEPS, in the stick circuit for relay TEPS, and is therefore energized insufficiently for closing contact 11 of time element device TE or for retaining this contact closed; and relay FR and crossing signal XS are deenergized.

Relay ASR is energized by its stick circuit passing from terminal B, through contact 5 of relay 1TR, contact 6 of relay ASR, and the winding of relay ASR to terminal N. Relay TEPS is also energized by a stick circuit, passing from

terminal B, through contact 8 of relay ASR, control element 9 of time element device TE, front point of contact 10 of relay TEPS, and the winding of relay TEPS to terminal N.

Control element 9 of time element device TE, on account of being included in series with the winding of relay TEPS, is not receiving sufficient energy for closing its front contact 11, and therefore contact 11 is open, and its back contact 12 is closed. The charging circuit is completed for capacitor *t*, and is the same as the stick circuit traced for relay TEPS as far as the front point of contact 10 of relay TEPS, and then passes through contact 12 of time element device TE, resistor *r*, and capacitor *t* to terminal N. Control element 9 of time element device TE is therefore also in series with resistor *r* and capacitor *t* and this too prevents control element 9 of time element device TE from receiving sufficient energy to close its front contact 11 and open its back contact 12.

Relay TEPP is energized by an obvious circuit which includes contact 13 of relay TEPS.

Relay XR is energized by a circuit passing from terminal B, through contact 14 of relay TEPP in multiple with contact 15 of relay ASR, contact 16 of relay XTR, and the winding of relay XR to terminal N.

I shall assume that, with apparatus embodying my invention as shown in the accompanying drawing, an eastbound train enters section 1T, deenergizing relay 1TR. On account of relay 1TR being deenergized, its contact 5 will open the stick circuit traced for relay ASR, causing relay ASR to become deenergized. The stick circuit traced for relay TEPS and the charging circuit for capacitor *t* will then be opened at contact 8 of relay ASR. Current will now be discharged from capacitor *t*, through resistor *r*, contact 12 of time element device TE, and the winding of relay TEPS back to capacitor *t*. Relay TEPS will be rendered slow releasing by the energy thus dissipated from capacitor *t*. Contact 13 of relay TEPS will therefore be retained closed for a brief period of time, so that relay TEPP will remain energized for a brief period of time. Although contact 15 of relay ASR opens, in the control circuit traced for relay XR, relay XR is retained energized for a period of time by current passing through contact 14 of relay TEPP.

By the time that contact 13 of relay TEPS has been released, and in turn contact 14 of relay TEPP has opened and caused relay XR to be deenergized, the eastbound train will have arrived at a location designated on the drawing as the starting point. The location of this starting point will of course be different for different trains, depending on their speed, so that, the higher the speed of the train, the farther the starting point will be from the entering end of section 1T, and the nearer it will be to the crossing. The parts of the apparatus are so proportioned that, for trains traveling at the highest speed, the starting point will be far enough from the intersection to provide ample warning to users of the highway.

When relay XR becomes deenergized, relay FR will become energized by its circuit passing from terminal B, through contact 17 of relay XR, and the winding of relay FR to terminal N. Relay FR, upon thus becoming energized, will oscillate its movable contact element 19 to repeatedly engage the fixed contact elements *a* and *b* alternately. Lamp 2*e* will therefore be lighted by a circuit passing from terminal B, through contact 18 of relay XR, contact 19–*a* of relay FR, and lamp 2*e* to terminal N. When the movable contact element 19 engages fixed element *b*, lamp 1*e* will be lighted by its circuit passing from terminal B, through contact 18 of relay XR, contact 19–*b* of relay FR, and lamp 1*e* to terminal N.

When the train enters section XT, deenergizing relay XTR, contact 16 of relay XTR will open the circuit for relay XR at another point.

When the train leaves section 1T, relay ASR will become energized by its pickup circuit passing from terminal B, through contact 5 of relay 1TR, contact 7 of relay TEPP, and the winding of relay ASR to terminal N. Relay ASR, upon thus becoming energized, will complete its stick circuit previously traced. With relay ASR energized, its contact 15 will be closed in the circuit previously traced for relay XR, which circuit will however still be open at contact 16 of relay XTR, and therefore relay XR will remain deenergized.

Contact 8 of relay ASR, upon becoming closed, completes an energizing circuit for time element device TE, this circuit passing from terminal B, contact 8 of relay ASR, control element 9 of time element device TE, and the back point of contact 10 of relay TEPS to terminal N.

Upon the lapse of a measured period of time determined by time element device TE, front contact 11 of time element device TE will become closed, thereby completing a pickup circuit for relay TEPS, this circuit passing from terminal B, through contact 8 of relay ASR, contact 11 of time element device TE, and the winding of relay TEPS to terminal N. Relay TEPS, upon thus becoming energized, will complete its stick circuit previously traced.

With control element 9 of time element device TE in series with the winding of relay TEPS, the energization of control element 9 will be reduced to such an extent that contact 11 of time element device TE will open, and, upon the lapse of a further measured period of time, contact 12 of time element device TE will become closed. When contact 12 of time element device TE becomes closed, the charging circuit will be completed for capacitor *t*, as previously described.

With contact 13 of relay TEPS now closed, relay TEPP will again become energized by its circuit previously described. Contact 14 of relay TEPP will therefore again be closed. With contact 7 of relay TEPP now open, the pickup circuit traced for relay ASR will be open, but relay ASR will remain energized by its stick circuit previously traced.

On account of relay ASR having been energized as soon as the train left section 1T, a circuit will be completed for energizing relay XR as soon as the train leaves section XT, permitting relay XTR to close its contact 16. Relay XR will therefore open its contacts 17 and 18, deenergizing relay FR and signal XS as soon as the train has vacated section XT. All parts of the apparatus shown in the accompanying drawing will therefore again be in the normal condition.

I shall now assume that, with all parts of the apparatus, shown in the accompanying drawing, again in their normal condition, an eastbound train enters section 1T, deenergizing relay 1TR, which in turn causes relays ASR and TEPS to be deenergized, as previously described. I shall assume further that a momentary loss of track circuit shunt of section 1T occurs before relay TEPS has released its front contacts. Relay TEPP will therefore still be energized, and its contact 7 will be open, so that the pickup circuit for relay ASR will not become closed for energizing relay ASR.

When relay TEPS releases its front contacts at the end of the slow release period provided by the discharge of energy from capacitor *t*, as previously described, relay TEPP will become deenergized and the pickup circuit previously traced for relay ASR will be completed.

As soon, however, as the momentary loss of shunt ends, contact 5 of relay 1TR will again become opened, causing relay ASR to again be deenergized. It follows that, after contact 14 of relay TEPP becomes opened at the end of the release period of relay TEPS, contact 15 of relay ASR can be closed for only a very brief period of the momentary loss of shunt remaining, and that therefore the highway crossing signal XS can be operated, at the most, for only the duration of the momentary loss of shunt.

I shall next assume that all parts of the apparatus shown in the accompanying drawing are again returned to the normal condition, and that relay ASR becomes deenergized by an eastbound train entering section 1T, causing relay TEPS and, in turn, upon the lapse of a delay period, relay TEPP also to become deenergized, so that relay XR is deenergized and the operation of signal XS is started. I shall assume further that a momentary loss of shunt then occurs, so that contact 5 of relay 1TR completes the pickup circuit for relay ASR. Relay ASR, upon closing its contact 15, closes a circuit for energizing relay XR which then interrupts operation of signal XS. With relay ASR energized, the energizing circuit for control element 9 of time element device TE will be completed, as previously traced, but before time element device TE can close its contact 11 for completing a pickup circuit for relay TEPS, the loss of shunt will be ended. With relay 1TR again deenergized, relay ASR will in turn also become deenergized, and its contact 15 will open the circuit for relay XR, so that the operation of signal XS will be resumed.

From the foregoing description of the operation of apparatus embodying my invention, as shown in the accompanying drawing, it is clear that, with my invention, if a loss of track circuit shunt occurs at any time while a train is on section 1T, relay TEPS cannot become energized until the lapse of a measured period of time required for closing contact 11 of time element device TE. The period of time required for device TE to close its front contact 11 is longer than the duration of any momentary loss of track circuit shunt that might be expected, and therefore relay TEPS will not close its front contacts because of any such momentary loss of shunt. The capacitor *t* cannot become charged until the lapse of a still further measured period of time determined by the time required for time element device TE to close its back contact 12.

It follows, therefore, that, with apparatus embodying my invention, the only interruption to the operation of signal XS that can occur due to a momentary loss of track circuit shunt of section 1T will be for the brief period of the momentary loss of track circuit shunt, and this period of interruption of the operation of signal XS cannot be extended by the delay means comprising capacitor *t* and resistor *r* for normally delaying the starting of the operation of signal XS when a train enters section 1T.

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

Having thus described my invention, what I claim is:

1. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form a crossing section including the intersection and an approach control section adjacent one end of said crossing section, each of said sections being provided with a track circuit including a source of current and a track relay which is normally energized but which becomes deenergized in response to occupancy of the corresponding section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, an approach stick relay, a time element device having a control element and having a back contact which becomes opened and also a front contact which becomes closed when said control element has been energized a given measured period of time by current of suitable magnitude, said front contact again becoming opened and said back contact again becoming closed when the energization of said control element has been reduced and maintained below a given level for a second measured period of time, an energy storing device, a control stick relay, a repeater relay controlled by a front contact of said control stick relay, a pickup and a stick circuit for said approach stick relay each controlled by a front contact of the track relay for said approach control section and said pickup circuit also controlled by a back contact of said repeater relay, means controlled by a front contact of said approach stick relay and by a back contact of said control stick relay for energizing the control element of said time element device, a pickup and a stick circuit for said control stick relay each controlled by a front contact of said approach stick relay and said pickup circuit also controlled by said front contact of said time element device and said stick circuit including said control element of said time element device, a path in multiple with the control winding of said control stick relay including said energy storing device in series with said back contact of said time element device, and means controlled by a front contact of said repeater relay in multiple with a front contact of said approach stick relay both in series with a front contact of the track relay for said crossing section for controlling said highway crossing signal.

2. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form a crossing section including the intersection and an approach control section adjacent one end of said crossing section, each of said sections being provided with a track circuit including a source of current and a track relay which is normally energized but which becomes deenergized in response to occupancy of the corresponding section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, an approach stick relay, a time element device having a control element and having a back contact which becomes opened and also a front contact which becomes closed when said control element has been energized a given measured period of time by current of suitable magnitude, said front contact again becoming opened and said back contact again becoming closed when the energization of said control element has been reduced and maintained below a given level for a second measured period of time, an energy storing device, a control stick relay, a pickup and a stick circuit

for said approach stick relay each controlled by a front contact of the track relay for said approach control section and said pickup circuit also controlled by a contact which becomes closed in response to deenergization of said control stick relay, means controlled by a front contact of said approach stick relay and by a back contact of said control stick relay for energizing the control element of said time element device, a pickup and a stick circuit for said control stick relay each controlled by a front contact of said approach stick relay and said pickup circuit also controlled by the front contact of said time element device, said energy storing device included in series with said back contact of said time element device in a path in multiple with the control winding of said control stick relay, and means controlled by a front contact of said control stick relay in multiple with a front contact of said approach stick relay and including a front contact of the track relay for said crossing section for controlling said highway crossing signal.

3. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form a crossing section including the intersection and an approach control section adjacent one end of said crossing section, each of said sections being provided with a track circuit including a source of current and a track relay which is normally energized but which becomes deenergized in response to occupancy of the corresponding section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, an approach stick relay, a control stick relay, a slow pickup and slow release time element device having a front contact which closes upon the lapse of a measured period of time after said time element device becomes energized and having a back contact which closes upon the lapse of a second measured period of time after energy is removed from said time element device, an energizing circuit for said time element device controlled by a front contact of said approach stick relay and by a back contact of said control stick relay, a pickup and a stick circuit for said control stick relay each controlled by a front contact of said approach stick relay and said pickup circuit also controlled by the front contact of said time element device, an energy storing device, a path including said energy storing device in series with the back contact of said time element device connected across the control winding of said control stick relay, a pickup and a stick circuit for said approach stick relay each controlled by a front contact of the track relay for said approach control section and said pickup circuit also controlled by a contact which becomes closed in response to deenergization of said control stick relay, and means controlled by a front contact of said control stick relay in multiple with a front contact of said approach stick relay and in series with a front contact of the track relay for said crossing section for controlling said highway crossing signal.

4. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form an approach control section adjacent said intersection, said approach control section being provided with a track circuit including a source of current and a track relay which is normally energized but becomes deenergized in response to occupancy of said approach section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, an approach stick relay, a control stick relay, a slow pickup and slow release time element device having a front contact which becomes closed upon the lapse of a measured period of time after said time element device becomes energized and having a back contact which becomes closed upon the lapse of a second measured period of time after energy is removed from said time element device, means controlled by a front contact of said approach stick relay and by a back contact of said control stick relay for energizing said time element device, a pickup and a stick circuit for said control stick relay each controlled by a front contact of said approach stick relay and said pickup circuit also controlled by said front contact of said time element device, an energy storing device, a circuit path including said energy storing device and said back contact of said time element device connected across the winding of said control stick relay, a pickup and a stick circuit for said approach stick relay each controlled by a front contact of the track relay for said approach section and the pickup circuit also controlled by a contact which becomes closed when said control stick relay becomes deenergized, and means including a front contact controlled by said control stick relay in multiple with a front contact of said approach stick relay for controlling said highway crossing signal.

5. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form an approach control section adjacent said intersection, said approach control section being provided with a track circuit including a source of current and a track relay which is normally energized but becomes deenergized in response to occupancy of said approach section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, a control stick relay, time element means, means controlled by a back contact of said control stick relay and by a front contact of said track relay for energizing said time element means, means controlled by said time element means for effecting energization of said control stick relay by a pickup circuit upon the lapse of a measured period of time after said track relay becomes energized, a stick circuit for then retaining said control stick relay energized while said track relay remains energized, an energy storing device, means controlled by said time element means and by said control stick relay for charging said energy storing device upon the lapse of a further period of time after said control stick relay becomes energized, means including said energy storing device for rendering said control stick relay slow to release when said track relay becomes deenergized, and means including a front contact controlled by said control stick relay for withholding operation of said highway crossing signal for a brief period of time after said track relay becomes deenergized.

6. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form an approach control section adjacent said intersection, said approach control section being provided with a track circuit including a source of current and a track relay which is normally ener-

gized but becomes deenergized in response to occupancy of said approach section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, an approach stick relay, a control stick relay, time element means, a pickup and a stick circuit for said approach stick relay each controlled by a front contact of said track relay and said pickup circuit also controlled by a contact which becomes closed in response to deenergization of said control stick relay, means controlled by a front contact of said approach stick relay and by a back contact of said control stick relay for energizing said time element means, means controlled by said time element means for effecting energization of said control stick relay by a pickup circuit upon the lapse of a measured period of time after said approach stick relay becomes energized, a stick circuit controlled by a front contact of said approach stick relay for then retaining said control stick relay energized, an energy storing device, means controlled by said time element device and by said control stick relay for charging said energy storing device upon the lapse of a further period of time after said control stick relay becomes energized, means including said energy storing device for rendering said control stick relay slow to release when said approach stick relay becomes deenergized, and means controlled by a front contact of said control stick relay for withholding operation of said highway crossing signal for a brief period of time after said approach stick relay becomes deenergized.

7. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form an approach control section adjacent said intersection, said section being provided with a track circuit including a source of current and a track relay which is normally energized but becomes deenergized in response to occupancy of said approach section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, a control stick relay, time element means, means controlled by a back contact of said control stick relay and by a front contact of said track relay for energizing said time element means, means controlled by said time element means for effecting energization of said control stick relay by a pickup circuit upon the lapse of a measured period of time after said track relay becomes energized, a stick circuit for then retaining said control stick relay energized while said track relay remains energized, an

energy storing device, means controlled by said time element means and by said control stick relay for charging said energy storing device upon the lapse of a further period of time after said control stick relay becomes energized, a circuit path including said energy storing device connected across the control winding of said control stick relay, and means controlled by a front contact of said control stick relay for withholding operation of said highway crossing signal for a period of time after said track relay becomes deenergized.

8. In a control system for a highway crossing signal adjacent the intersection of a highway with a railway track which is divided to form an approach control section adjacent said intersection, said section being provided with a track circuit including a source of current and a track relay which is normally energized but becomes deenergized in response to occupancy of said approach section by a train, the combination embodying means for protecting against momentary losses of shunt of an approach control section comprising, a control stick relay, time element means, means controlled by said control stick relay and by said track relay for energizing said time element means when said track relay becomes energized, means controlled by said time element means for energizing said control stick relay upon the lapse of a measured period of time after said track relay becomes energized, stick circuit means controlled by said track relay for then retaining said control stick relay energized while said track relay remains energized, an energy storing device, means including a front contact of said control stick relay for effecting charging of said energy storing device, means embodying said energy storing device for rendering said control stick relay slow to release when said track relay becomes deenergized, and control means including a front contact of said control stick relay for withholding operation of said highway crossing signal for a period of time after said track relay becomes deenergized.

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