April 17, 1951 J. J. VAN HORN 2,549,146

TRAFFIC DETECTING MEANS FOR PROTECTING OPERATION OF RAILWAY TRACK SWITCHES AND THE LIKE

Filed July 3, 1946 2 Sheets-Sheet 1

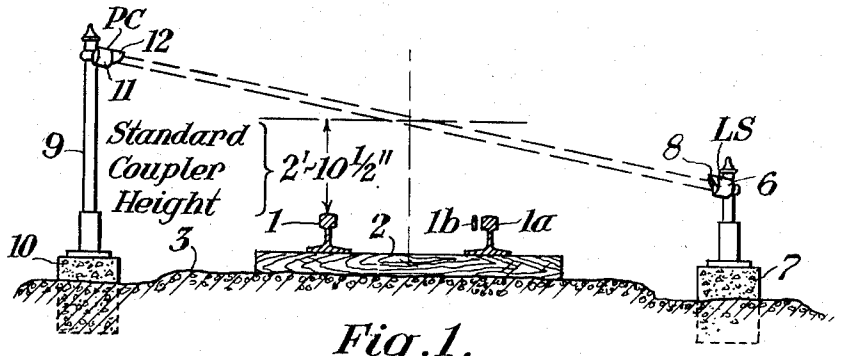

Fig. 1.

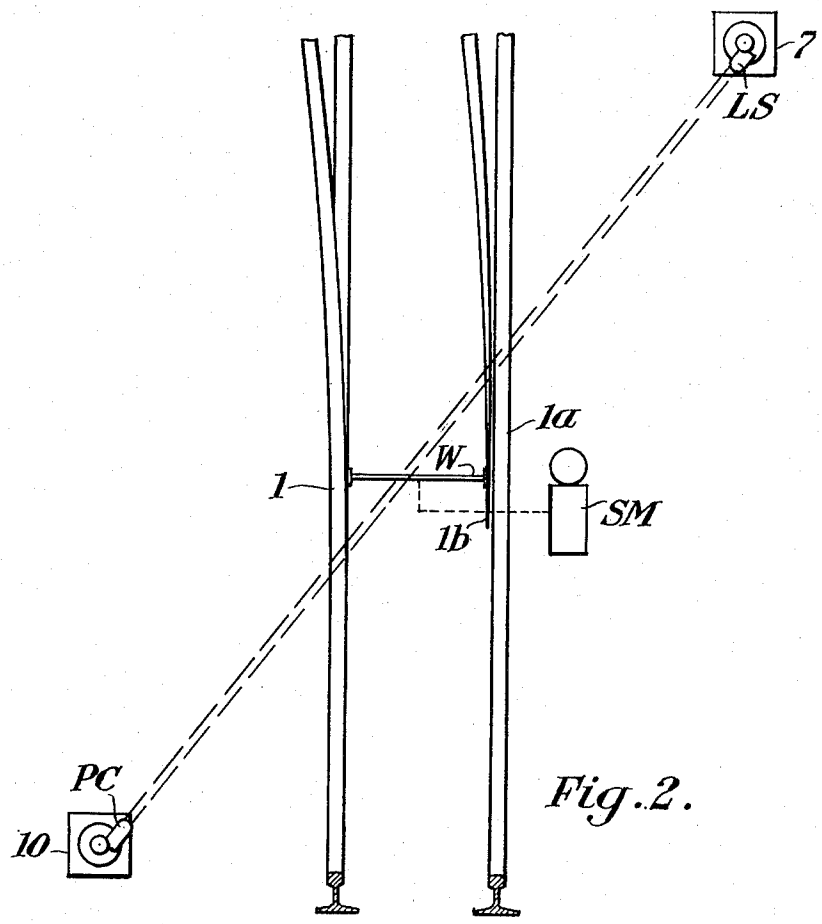

Fig. 2.

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2 Sheets-Sheet 2

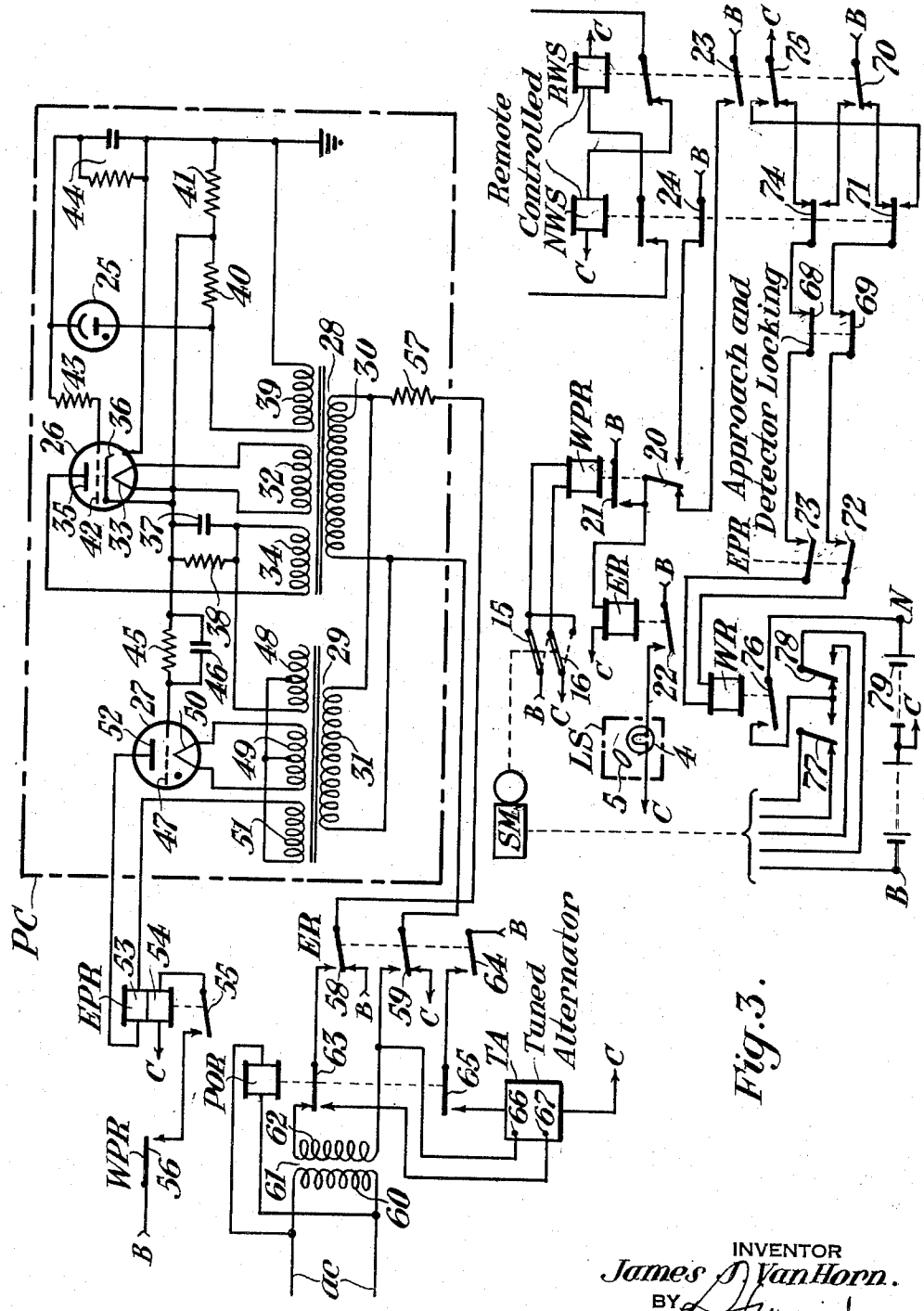

Fig. 3.

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2,549,146

TRAFFIC DETECTING MEANS FOR PROTECTING OPERATION OF RAILWAY TRACK SWITCHES AND THE LIKE

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Application July 3, 1946, Serial No. 681,171

3 Claims. (Cl. 246—160)

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My invention relates to traffic detecting means for protecting operation of railway track switches and the like, and particularly to traffic detecting systems including means for optically detecting the presence of traffic in a selected portion of railroad track.

It is customary in railway signaling practice to detect traffic in a selected portion of railway track by means of track circuits which require that an effective low-resistance connection be established across the track rails by the wheels and axles of a vehicle. The sensitivity and reliability of track circuits are dependent upon the electrical contact between the rails and wheels of a vehicle, and it sometimes happens that due to the formation of scale and rust on infrequently used track rails, or the deposition of sand or other foreign elements on the rails, a reliable low-resistance contact between the rails and wheels is difficult to obtain. In such cases it has been proposed to supplement or substitute for the track circuit detecting means, means for optically detecting traffic using a beam of light on one side of the track projected across the track for actuating a light sensitive cell on the other side of the track. The cell is utilized to reflect the presence or absence of traffic in the selected portion of track according as the beam is or is not interrupted.

In accordance with my present invention I supplement the usual track circuit controlled traffic detection means by an optical traffic detecting means arranged normally to be deenergized and placed in an active condition when and only when detection of traffic is required in protecting the operation of a traffic governing device. For example, detection of traffic is required at a switch location primarily to protect the operation of the switch points, that is, the switch operating apparatus is controlled so as to lock the points in their last-occupied position and is arranged to be unlocked to provide for shifting the points to another position if and only if traffic conditions adjacent the switch are such as not to be endangered by operation of the points. In such applications, therefore, the optical traffic detecting means need be in an active condition only when a control is initiated which if effective will cause the points to shift. My invention has for its objects the provision of novel and improved means for rendering active the optical detecting means upon the initiation of such a control, and for using the optical detecting means in a novel and improved manner in conjunction with the usual track circuit detecting means to permit operation of the points after both detecting means establish that traffic conditions are proper for such operation.

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In employing the optical detecting means for this purpose, I provide a relay which is picked up by the light-sensitive portion of the optical detecting means, when active, provided that the beam projected to activate the light-sensitive unit is not intercepted, as by a vehicle adjacent the switch location, and which relay once picked up is provided with a stick circuit established when the switch becomes unlocked for movement. The pick up of the relay checks that the points are free of traffic, while the relay is held energized in its stick circuit when operation of the switch has been started, in order to assure that the switch operation will be completed and not be stopped in mid-stroke if the beam should be intercepted or interrupted subsequent to the relay picking up.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a front elevation view showing the arrangement of the parts of the apparatus embodying my invention. Fig. 2 is a top view of the apparatus illustrated in Fig. 1. Fig. 3 is a diagrammatic view of the apparatus embodying my invention and shown in Figs. 1 and 2. In each of the views, similar reference characters refer to the same parts.

Referring to the drawings, the reference characters 1 and 1*a* designate the rails of a railroad track, mounted in the usual manner on ties 2 supported in road-bed 3, while the reference character 1*b* designates a movable point of a railway track switch W shown in Fig. 2. A light source LS comprising an electric lamp 4 and a collimating lens 5 (see Fig. 3) mounted in a weatherproof housing 6 is secured to a suitable base 7 in the roadway at one side of the track. A hood 8 provided on housing 6 screens the light source which is mounted to project its beam upwardly at a slight vertical angle across the rails 1 and 1*a* so as to cross the center line of the track at substantially 2 feet 10½ inches above the top of the rails. This is the standard coupler height and it is apparent that the beam will be intercepted by the passage of two or more cars coupled together, as well as by the body of a car disposed in the path of the beam. A light sensitive or photo-cell unit PC is mounted on a supporting member 9 secured to a base 10 imbedded in the roadway on the opposite side of the track with the light sensitive cell of unit PC disposed in the path of the beam from source LS. The unit PC is mounted in a weatherproof housing 11 provided with a hood 12. As indicated in Fig. 2, the photo-cell unit PC is mounted at a horizontal angle with respect to source LS so that the beam passes diagonally across the points of

track switch W. That is, the beam of source LS is directed at both a vertical and horizontal angle across the track so that a car approaching the points will intercept the beam before reaching the points and the beam will be intercepted as long as any portion of the car occupies the zone extending from in front of the points to some distance in the rear of the points.

As indicated in Figs. 2 and 3, switch W is arranged for remote operation by means of a switch operating mechanism SM which may be of the usual construction. Mechanism SM is provided (see Fig. 3) with circuit controlling contacts 15 and 16 which repeat the position of switch W and which control a polarized switch repeater relay WPR. When switch W is locked in its normal position, as indicated in Fig. 2, relay WPR is energized by current of one polarity over a circuit extending from one terminal B of a suitable source of current, such as a battery 79, through contact 15, the winding of relay WPR in one direction, and contact 16 to the other terminal C of the source of current. When switch W is reversed and locked, the contacts 15 and 16 are shifted to the dotted positions shown in Fig. 3 so that the energization of relay WPR is reversed, as is obvious from an inspection of the drawing. The polar contact 20 of relay WPR is operated to its left-hand or its right-hand position (as viewed in the drawing) according as relay WPR is energized by current of one polarity or the other. Contacts 15 and 16 are opened when mechanism SM is unlocked to permit movement of the points of switch W, and in such event relay WPR is deenergized and released to close its back contacts.

The switch mechanism SM is governed by means of remote control relays NWS and RWS which may comprise a portion of a centralized traffic control system of the type shown, for example, in Letters Patent of the United States No. 2,229,249, granted on January 21, 1941, to L. V. Lewis. Each relay NWS and RWS is controlled over a back contact of the other relay so that either one but not both relays can be picked up at any one time. The relays NWS and RWS correspond respectively to the normal and reverse switch control relays of a centralized traffic control system and control mechanism SM in such manner that switch W normally occupies a position in correspondence with the energized condition of the switch control relays. That is, when normal switch control relay NWS is picked up and conditions are favorable for operation of switch W, the points of the switch are operated to and locked in their corresponding normal positions, while if reverse switch control relay RWS is picked up when conditions are favorable for movement of the points, the points are operated to and locked in their corresponding reverse positions. The control of mechanism SM by relays NWS and RWS will be explained in detail hereinafter.

The reference character ER designates a relay governed by relays NWS and RWS in cooperation with relay WPR, the arrangement being such that relay ER is energized whenever the position of switch W is out of correspondence with the energization of the control relays NWS and RWS; or whenever relay WPR is released due to switch W being in transit between its normal and reverse positions. That is, if reverse switch control relay RWS is picked up when switch W occupies its normal position as reflected by polar contact 20 of relay WPR in its left-hand position, a circuit for relay ER is completed from terminal B through front contact 23 of relay RWS, polar contact 20 of relay WPR in its left-hand position and the winding of relay ER to terminal C; while if normal switch control relay NWS is picked up with switch W reversed so that polar contact 20 of relay WPR occupies its right-hand position, relay ER is energized over a circuit from terminal B through front contact 24 of relay NWS, polar contact 20 of relay WPR in its right-hand position, and the winding of relay ER to terminal C. Also, relay ER is energized when back contact 21 of relay WPR is closed to complete an obvious circuit for relay ER. Relay ER controls the energization of lamp 4 of light unit LS over an obvious circuit including front contact 22 of relay ER, and also controls the energization of photo-cell unit PC in a manner explained hereinafter.

The photo-cell unit PC includes a light sensitive cell 25 connected in the grid circuit of an amplifying tube 26 which in turn controls a hot cathode gas triode tube 27. The power supply for unit PC comprises two transformers 28 and 29 provided respectively with primary windings 30 and 31 connected in parallel. Transformer 28 has a secondary winding 32 connected across the two leads of filament 33 of tube 26; another secondary winding 34 of transformer 28 is connected across plate 35 and cathode 36 of tube 26 in series with a biasing unit consisting of a capacitor 37 and a resistor 38 in multiple; and another secondary winding 39 of transformer 28 is connected across two resistors 40 and 41 in series, which resistors function as a voltage divider. The junction terminal of resistors 40 and 41 is connected to cathode 36 of tube 26, and the outside terminal of resistor 41 is connected through a resistor 43 and a biasing unit 44, comprising a resistor and condenser connected in multiple, to grid 42 of tube 26 to complete the grid circuit of that tube. When winding 30 of transformer 28 is supplied with alternating current, current can flow in the plate circuit of the tube 26 only during the one-half cycles that plate 35 is positive with respect to cathode 36, but normally such current flow is substantially blocked by the bias potential between cathode 36 and grid 42 equal to the voltage drop across resistor 41, the grid 42 being made negative with respect to cathode 36 by this biasing potential during each of the half-cycles that plate 35 is positive in the plate circuit.

Photo-cell 25 has one terminal connected to the outside terminal of resistor 40 and has its other terminal connected to the grid 42 of tube 26 through resistor 43. The cell 25 is normally non-conducting when not subjected to illumination, but when subjected to light of a sufficient intensity such as is projected from source LS, the cell 25 becomes conducting and the current passed by the cell in its conducting state crates a voltage drop in biasing unit 44 which opposes the voltage drop of resistor 41 applied across cathode 36 and grid 42. As a result, there is an increase in the anode current of tube 26 so that an increased voltage drop appears across resistor 38 in the output circuit of that tube.

The gas filled triode 27 has its cathode 50 connected across secondary winding 49 of transformer 29, and has an output circuit comprising secondary winding 51 of transformer 29 connected to cathode 50 through a center-tap of winding 49, and to plate 52 of tube 27 through one winding 53 of a two-winding relay EPR. The

grid circuit of tube 27 includes another secondary winding 48 of transformer 29, which has one terminal connected to cathode 50 through the center-tap connection of winding 49, and has its other terminal connected to grid 47 of tube 27 through biasing unit 37—38 of the plate circuit of tube 26, and another biasing unit comprising a resistor 45 and condenser 46 connected in multiple.

When alternating current is supplied to winding 31, the gas filled triode tube 27 can conduct current during the one-half cycles of the alternating current that plate 52 is positive with respect to cathode 50 but so long as photo-cell 25 is not illuminated so that little if any voltage drop appears across resistor 38 in the grid circuit of tube 27, the flow of current in the anode circuit of tube 27 is prevented by the bias voltage of winding 48 that is applied across grid 47 and cathode 50 to make the grid negative with respect to cathode 50 during each half-cycle that plate 52 is positive. The tube 27 is controlled to its conducting condition by a reduction in the negative bias of grid 47 effected by the conductive condition of cell 25 in response to illumination which results in an increased anode current in the plate circuit of tube 26. This appears as an increased voltage drop across resistor 38 in the grid circuit of tube 27, and opposes the bias voltage of winding 48 to reduce the negative bias of grid 47 to a value such that tube 27 is made conducting, during each half-cycle of the alternating current that plate 52 is positive, so long as the cell 25 is illuminated.

The winding 53 of relay EPR is energized by the half-cycle pulses of unidirectional current passed by tube 27 when controlled to its conductive condition by the illumination of cell 25, and relay EPR accordingly picks up under the conditions assumed. Relay EPR has a second winding 54 which is energized in a stick circuit including its own front contact 55 and back contact 56 of relay WPR. Winding 54 is effective when energized to maintain relay EPR picked up so long as relay WPR is released, even if winding 53 should become deenergized due to tube 27 being controlled to its non-conducting condition.

The primary windings 30 and 31 of unit PC are normally supplied through a resistor 57 with direct current from terminals B and C over back contacts 58 and 59 of relay ER, the resistor 57 being disposed within the unit and normally being energized in order to maintain an elevated temperature in the unit and thereby prevent the deposition of moisture on the circuit elements. When relay ER is energized, front contacts 58 and 59 of relay ER close to shift the energization of windings 30 and 31 from terminals B and C to a source of alternating current indicated conventionally in the drawings by the reference characters *ac*, which is connected to the primary winding 60 of a transformer 61 which has its secondary winding 62 connected through front contacts 58 and 59 to windings 30 and 31 so as to energize the latter windings with alternating current.

A power-off relay POR is connected across primary winding 60 of transformer 61 and is energized so long as power is available from source *ac*. Relay POR has a front contact 63 interposed in the connection of one terminal of winding 62 to front contact 58 of relay ER, and operates upon a failure of power of the *ac* source to interrupt the connection of the source to windings 30 and 31 and to transfer those windings to a stand-by source of *ac* power supplied from a tuned alternator TA at times energized from the direct current source over a circuit from terminal B through front contact 64 of relay ER, back contact 65 of relay POR and the operating elements of the tuned alternator to terminal C. The tuned alternator operates in the customary manner so that when supplied with direct current from terminals B and C, alternating current is delivered to its output terminals 66 and 67. If the source *ac* should fail when relay ER is picked up, then alternating current derived from the direct current source through alternator TA is supplied to unit PC through a connection extending from terminal 66 of alternator TA through front contact 59 of relay ER to one terminal of windings 30 and 31, and a connection from terminal 67 of alternator TA through back contact 63 of relay POR, front contact 58 of relay ER and resistor 57 to the other terminal of windings 30 and 31.

The reference character WR designates a polarized switch operating relay governed by remote control relays NWS and RWS in cooperation with relay EPR and the usual detector and approach locking provided for the control of track switches in railway signaling practice. The detector and approach locking control is indicated conventionally in the drawing by contacts 68 and 69 which represent the usual locking circuits and apparatus controlled by track circuits arranged to permit front contacts 68 and 69 to close only when conditions adjacent switch W are such as to permit operation of the switch without danger to approaching traffic. Relay WR is energized by current of one polarity when relays NWS and EPR are picked up, and front locking contacts 68 and 69 are closed, over a circuit extending from terminal B through back contact 70 of relay RWS, front contact 71 of relay NWS, front locking contacts 69, front contact 72 of relay EPR, the winding of relay WR in one direction, front contact 73 of relay EPR, front locking contact 68, front contact 74 of relay NWS and back contact 75 of relay RWS to terminal C. When relay WR is energized over the circuit just traced, its front contact 76 is closed and its polar contacts 77 and 78 are operated to their normal or left-hand positions, as viewed in the drawing, to complete a circuit which connects a suitable source of current, such as a battery 79, to the operating motor of mechanism SM with the polarity of energization selected to cause the motor to operate the points of switch W to their normal positions indicated in Fig. 2. Current of the opposite polarity is supplied from battery 79 to the motor of mechanism SM when relay RWS is picked up and relay NWS is released, provided that relay EPR is picked up and front locking contacts 68 and 69 are closed, because in such event relay WR is supplied with current of the opposite polarity over a circuit from terminal B through front contact 70 of relay RWS, back contact 74 of relay NWS, front locking contact 68, front contact 73 of relay EPR, the winding of relay WR in the opposite direction, front contact 72 of relay EPR, front locking contact 69, back contact 71 of relay NWS and front contact 75 of relay RWS to terminal C. The energization of relay WR by current of the opposite polarity supplied over the circuit just traced results in front contact 76 closing and polar contacts 77 and 78 shifting to their reverse or right-hand positions as viewed in the drawing, thereby reversing the

polarity of current supplied from battery 79 to the motor of mechanism SM to cause the motor to operate the points of switch W to their reverse positions.

The apparatus embodying my invention is in its normal condition when the position of switch W corresponds to the energized condition of the remote control relays NWS and RWS. This condition obtains when switch W is in its normal position and relay NWS is picked up (as illustrated in the drawing) or when switch W is in its reverse position and relay RWS is picked up. In the normal condition of the apparatus, relay WPR is energized and its polar contact 20 is positioned in its normal or its reverse position according as switch W occupies its corresponding normal or reverse position; relay ER is released to deenergize lamp 4 of source LS and to energize resistor 57 of unit PC by unidirectional current; relays EPR and WR and tuned alternator TA are deenergized; and relay POR is energized to indicate that power is available from source *ac*.

In describing the operation of the apparatus embodying my invention, I shall assume that with the apparatus in the normal condition illustrated in the drawings, in which condition switch W occupies its normal position so that polar contact 20 of relay WPR occupies its corresponding normal position, the operator establishes control over relay RWS to pick up that relay for the purpose of controlling switch W to its reverse position. When that happens, switch W will be operated to its reverse position by mechanism SM provided that conditions adjacent to the switch as reflected by contacts 68 and 69 controlled by the detector and approach locking means, and by the picking up of relay EPR, are favorable for operation of the switch. That is, when relay RWS picks up, relay ER becomes energized over front contact 23 of relay RWS and polar contact 20 of relay WPR in its normal position, so that relay ER picks up to close its front contact 22 and energize lamp 4 of source LS, and to close its front contacts 58 and 59 to connect source *ac* to primary windings 30 and 31 of unit PC, thereby conditioning that unit for operation. If a vehicle occupies or is adjacent to the points of switch W so as to intercept the beam of source LS before it reaches cell 25, then conditions at the switch are not proper for operation of the switch and relay EPR will not pick up to prepare the circuit for switch control relay WR. However, if the switch W is free of vehicles so that the beam of source LS projects on cell 25 of unit PC, then cell 25 controls tube 26 to cause gas-filled triode 27 to become conducting and energize winding 53 of relay EPR. Relay EPR thereupon picks up to close its front contacts 72 and 73 in the previously traced circuit of relay WR, and if locking contacts 68 and 69 are closed to indicate that conditions adjacent the switch are favorable for its operation, relay WR is energized in its reverse direction over back contacts 71 and 74 of relay NWS and front contacts 70 and 75 of relay RWS. Front contact 76 of relay WR accordingly closes and its polar contacts 77 and 78 operate to their reverse positions to reverse the polarity of energization of the motor of mechanism SM and thereby cause the points of switch W to operate to their reverse positions. When the points of switch W become unlocked in the initial movement of mechanism SM, contacts 15 and 16 of the switch mechanism open in the circuit of relay WPR and that relay releases to close its back contact 21 which holds relay ER energized as long as relay WPR remains released. Also, back contact 56 of relay WPR closes in the stick circuit of winding 54 of relay EPR to hold that relay picked up as long as relay WPR is released.

When the points of switch W reach and are locked in their reverse positions, contacts 15 and 16 of switch mechanism SM are closed in their reverse positions (indicated by dotted lines in Fig. 3) so that relay WPR is energized in the opposite direction to open its back contacts 21 and 56, and to reverse its polar contact 20. Relay ER thereupon becomes deenergized to open the circuit of lamp 4 of source LS, and to shift the energization of unit PC back to the local source of direct current. Winding 53 of relay EPR also becomes deenergized and with back contact 56 of relay WPR open, winding 54 is deenergized so that relay EPR releases to open its contacts 72 and 73 in the previously mentioned energizing circuit for relay WR, whereupon that relay releases to open its front contact 76 and disconnect battery 79 from the motor of mechanism SM. The apparatus will now be in the condition where the points of switch W occupy their reverse positions, polar contact 20 of relay WPR is in its reverse position, and remote control relay RWS is picked up, so that the position of switch W corresponds with the energized condition of the remote control relays.

The switch W will be operated from its reverse to its normal position in a manner which will be readily apparent from the foregoing description, by the operator energizing remote control relay NWS, provided that conditions are favorable for operation of the switch as reflected by the picking up of relay EPR and the closed positions of front contacts 68 and 69 governed by the detector and approach locking circuits.

It is, of course, readily apparent that if power is not available from source *ac* when the operator governs a remote control relay in a manner to initiate operation of switch W, relay POR will be released so that when relay ER picks up, unit PC will be supplied with alternating current from terminals 66 and 67 of tuned alternator TA; and that if the source *ac* should fail during an operation of the switch, then relay POR will immediately release to shift the energization of unit PC to the tuned alternator TA. The alternator TA is controlled by relays ER and POR to be energized and to operate to supply alternating current from its output terminals 66 and 67 only at such times as the unit PC requires that current for operation.

From the foregoing description it is readily apparent that I have provided means for optically detecting the presence of traffic on a selected portion of railroad track when it is necessary to determine whether or not conditions are favorable for the operation of a traffic controlling device such as a track switch. The optical detecting means is employed in conjunction with the usual track circuit detecting means and supplements the latter in that both detecting means must indicate freedom from traffic in order to effect a control of the track switch. The invention is of particular utility in controlling the operation of a track switch at the end of a passing siding because the optical detecting means operates independently of track shunts established across the track rails by the wheels and axles of vehicles and therefore is free from interference due to the formation of rust and scale on infre-

quently used switch points and turn-outs, and of sand or other foreign elements deposited on the rails by locomotive's sanders to improve the adhesion of wheels on the track rails. The invention is arranged to be effective to exert a control only when necessary to detect traffic for certain proposed operations of traffic controlling devices, and at all other times is conditioned to be inoperative.

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

Having thus described my invention, what I claim is:

1. In combination with a railroad track switch having a normal and a reverse position, approach and detector locking means for said switch, switch indication means controlled by said switch for indicating the normal and reverse positions of said switch and also the transit position of said switch intermediate the normal and reverse positions, power operated means for operating said switch between its normal and reverse positions, remotely controlled means having a normal and a reverse condition for at times controlling said power operated means to operate said switch to a position of correspondence with said remotely controlled means, a source of light positioned at one side of said switch to project a beam across said switch so as to be intercepted by a vehicle occupying said switch or closely adjacent thereto, means for energizing said source to cause projection of said beam controlled by said switch and said remotely controlled means to be effective only when said switch position is out of correspondence with the condition of said remotely controlled means, light sensitive means disposed on the opposite side of said switch in the path of said beam, a relay, a pickup circuit for said relay controlled by said light sensitive means and effective when said means is activated by said beam, a stick circuit for said relay including its own front contact and completed when said switch indication means indicates the transit position of said switch, a switch control relay effective when energized to render active the control of said power operated means by said remotely controlled means, and an energizing circuit for said switch control relay including a front contact of said first mentioned relay and governed by said approach and detector locking means to be effective when and only when traffic conditions adjacent the switch are such as not to be endangered by operation of said switch.

2. In combination with a railroad track switch having a normal and a reverse position, approach and detector locking means for said switch, switch indication means controlled by said switch for indicating the normal and reverse positions of said switch and also the transit position of said switch intermediate the normal and reverse positions, power operated means for operating said switch between its normal and reverse positions, switch controlling means having a normal and a reverse condition for at times controlling said power operated means to operate said switch to a position of correspondence with said switch controlling means, traffic detecting means comprising a source of light positioned at one side of said switch to project a beam across said switch so as to be intercepted by a vehicle occupying said switch or closely adjacent thereto and light sensitive means disposed on the opposite side of said switch in the path of said beam, means controlled by said switch and said switch controlling means to be effective only when said switch position is out of correspondence with the condition of said switch controlling means for energizing both said source to cause projection of said beam and said light sensitive means to cause response to activation by said beam, a relay, a pickup circuit for said relay controlled by said light sensitive means and effective when said means is activated by said beam, a stick circuit for said relay including its own front contact and completed when said switch indication means indicates the transit position of said switch, a switch control relay effective when energized to render active the control of said power operated means by said switch controlling means, and an energizing circuit for said switch control relay including a front contact of said first mentioned relay and governed by said approach and detector locking means to be effective when and only when traffic conditions adjacent the switch are such as not to be endangered by operation of said switch.

3. In combination with a railroad track switch having a normal and a reverse position, approach and detector locking means for said switch, switch indication means controlled by said switch for indicating the normal and reverse positions of said switch and also the transit position of said switch intermediate the normal and reverse positions, power operated means for operating said switch between its normal and reverse positions, switch controlling means having a normal and a reverse condition for at times controlling said power operated means to operate said switch to a position of correspondence with said switch controlling means, traffic detecting means comprising a source of light positioned at one side of said switch to project a beam across said switch so as to be intercepted by a vehicle occupying said switch or closely adjacent thereto and light sensitive means disposed on the opposte side of said switch in the path of said beam, a relay, a pickup circuit for said relay controlled by said light sensitive means and effective when said means is activated by said beam, a stick circuit for said relay including its own front contact and completed when said switch indication means indicates the transit position of said switch, a switch control relay effective when energized to render active the control of said power operated means by said switch controlling means, and an energizing circuit for said switch control relay including a front contact of said first mentioned relay and governed by said approach and detector locking means to be effective when and only when traffic conditions adjacent the switch are such as not to be endangered by operation of said switch.

JAMES J. VAN HORN.

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