

W. D. NICKUM.
RAILWAY SIGNAL SYSTEM.

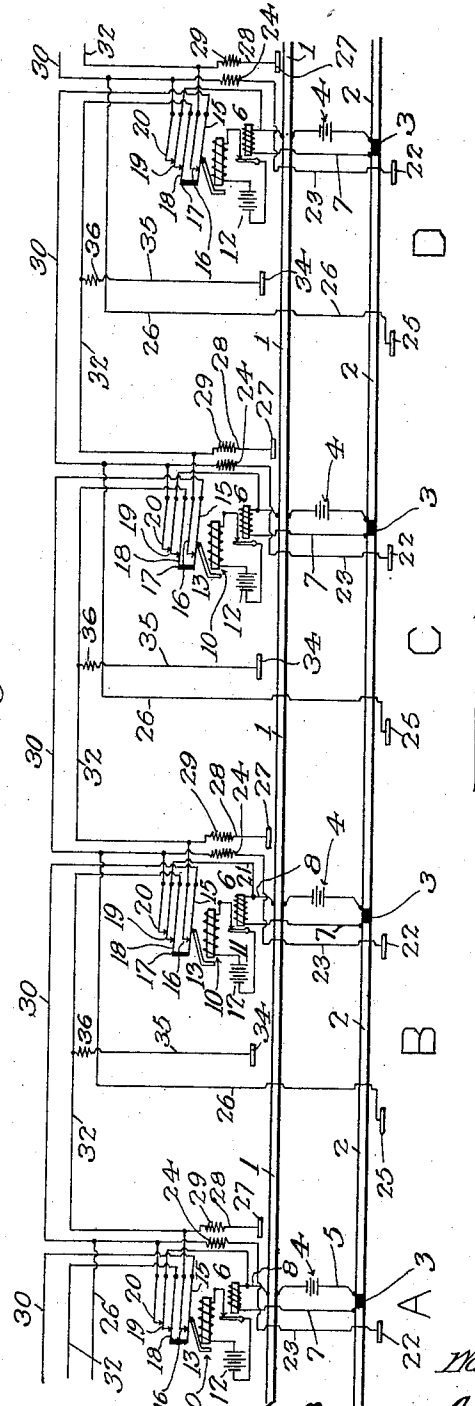
APPLICATION FILED APR. 2, 1909. RENEWED MAR. 19, 1913.

1,061,863.

Patented May 13, 1913.

8 SHEETS—SHEET 1.

Fig. 1.



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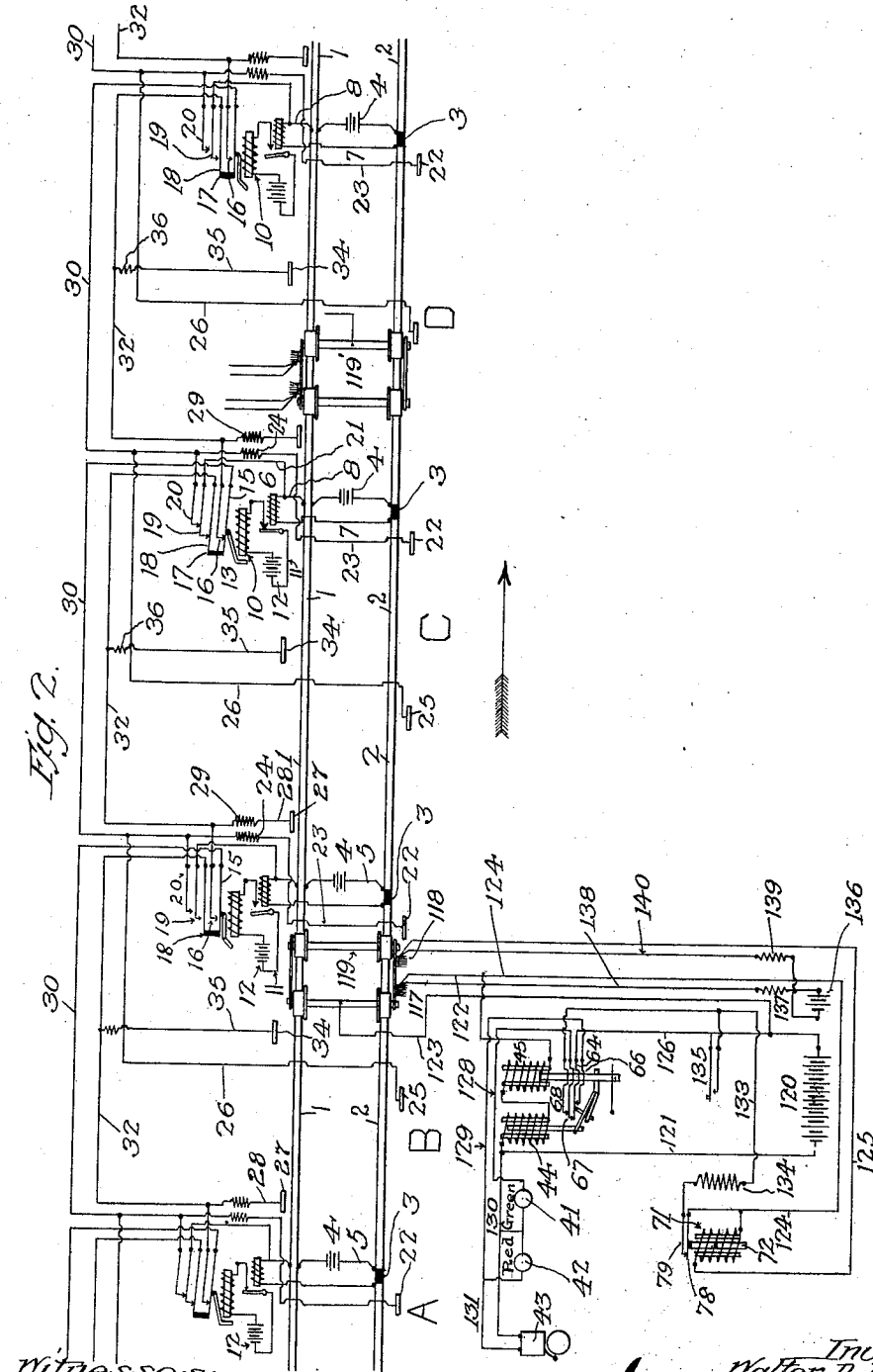
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8 SHEETS—SHEET 2.



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8 SHEETS—SHEET 4.

Fig. 5.

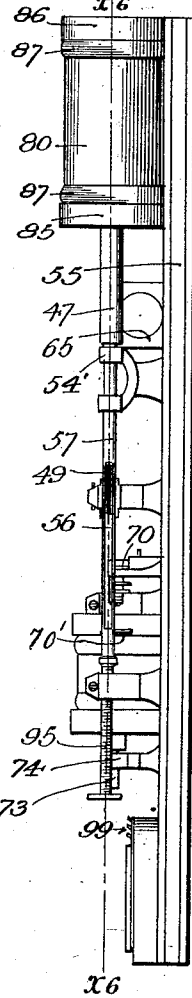


Fig. 6.

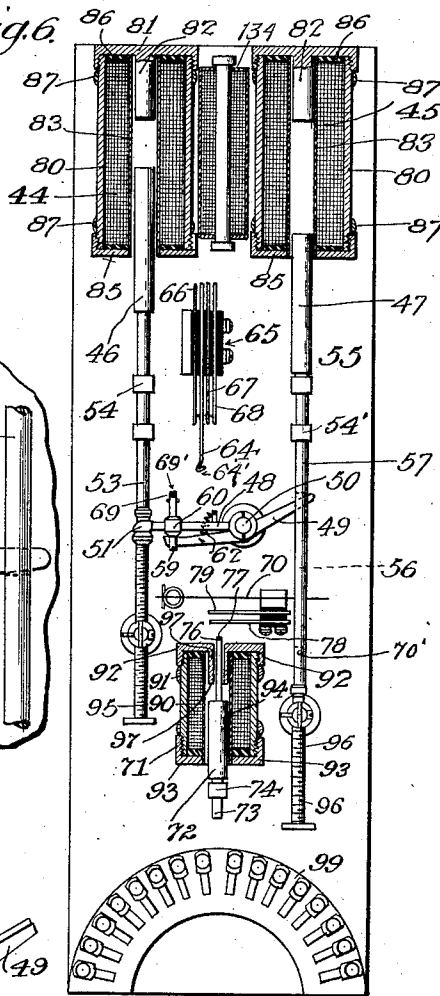


Fig. 7.

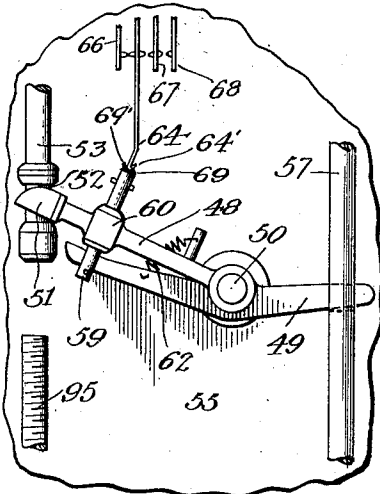
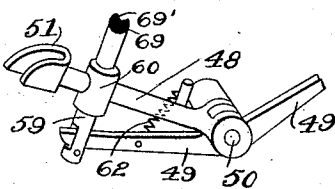


Fig. 7a



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Fig. 8.

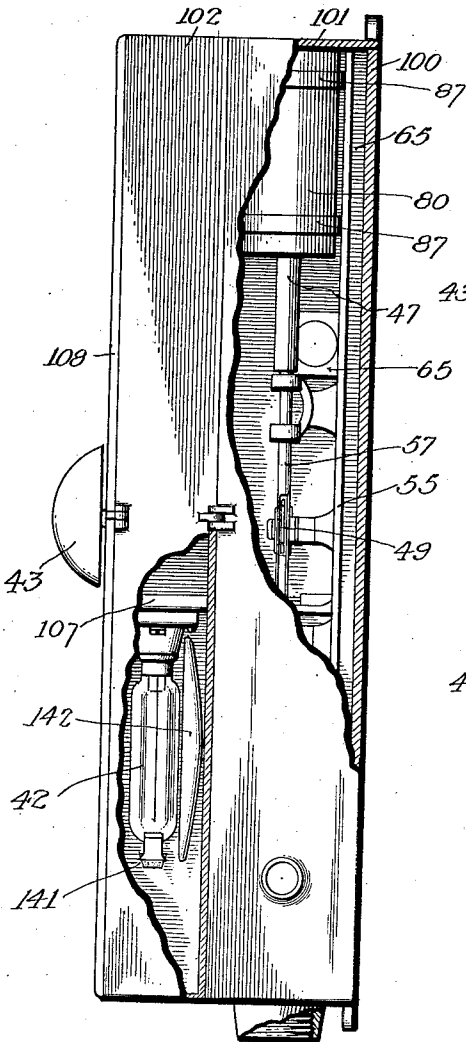


Fig. 9.

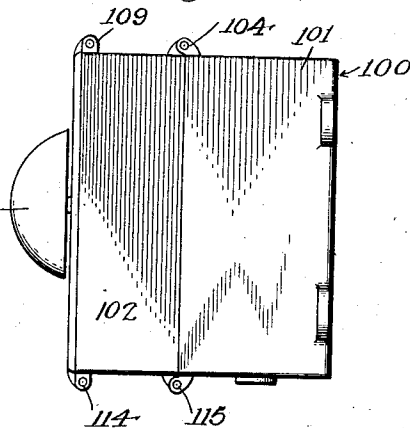
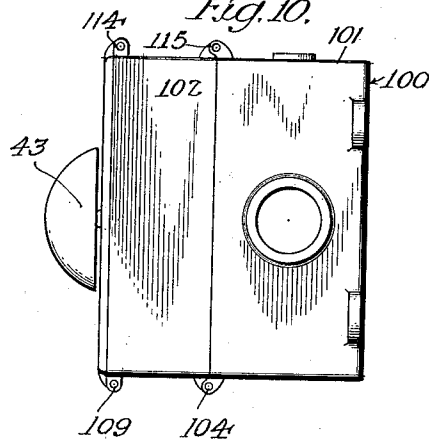


Fig. 10.



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RAILWAY SIGNAL SYSTEM.

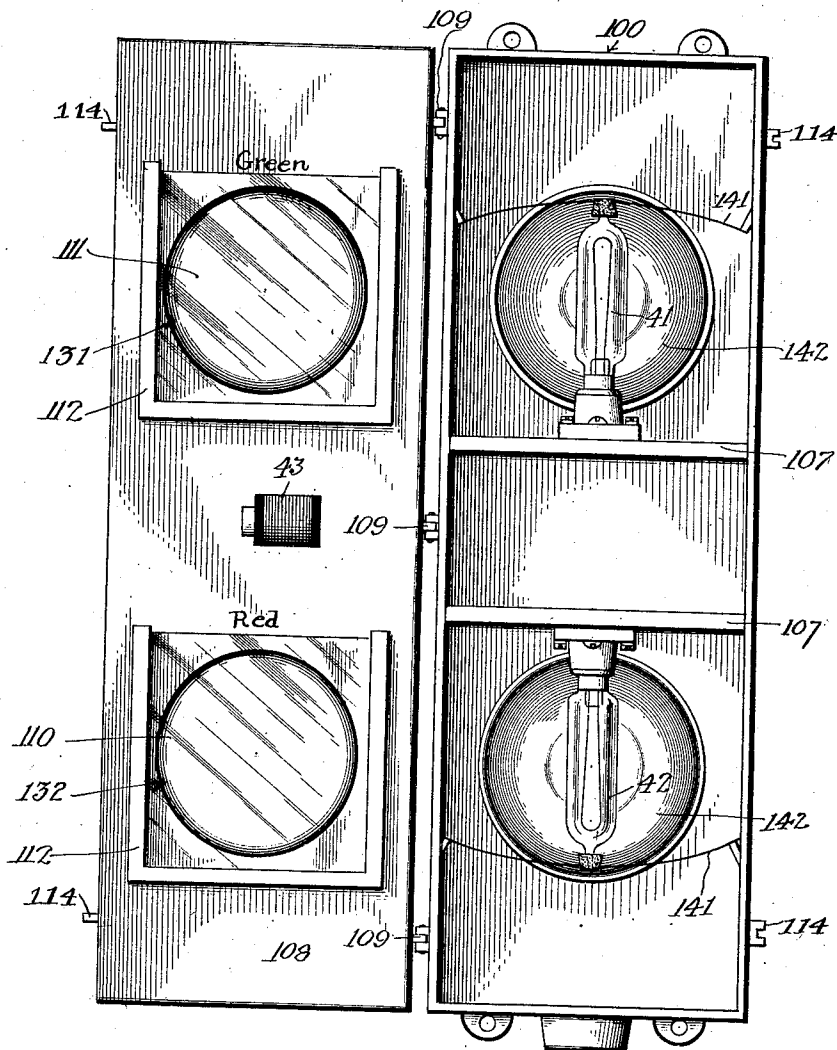
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8 SHEETS—SHEET 6.

Fig. 11.



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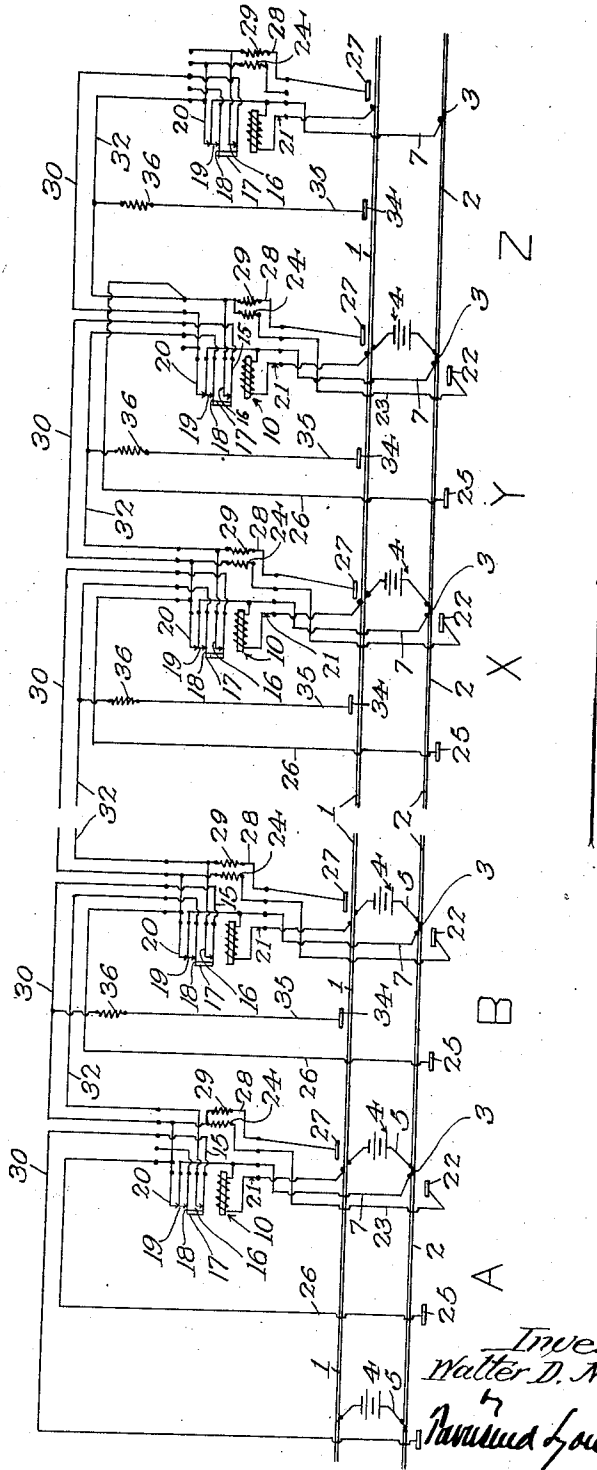
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8 SHEETS—SHEET 7.

Fig. 12.



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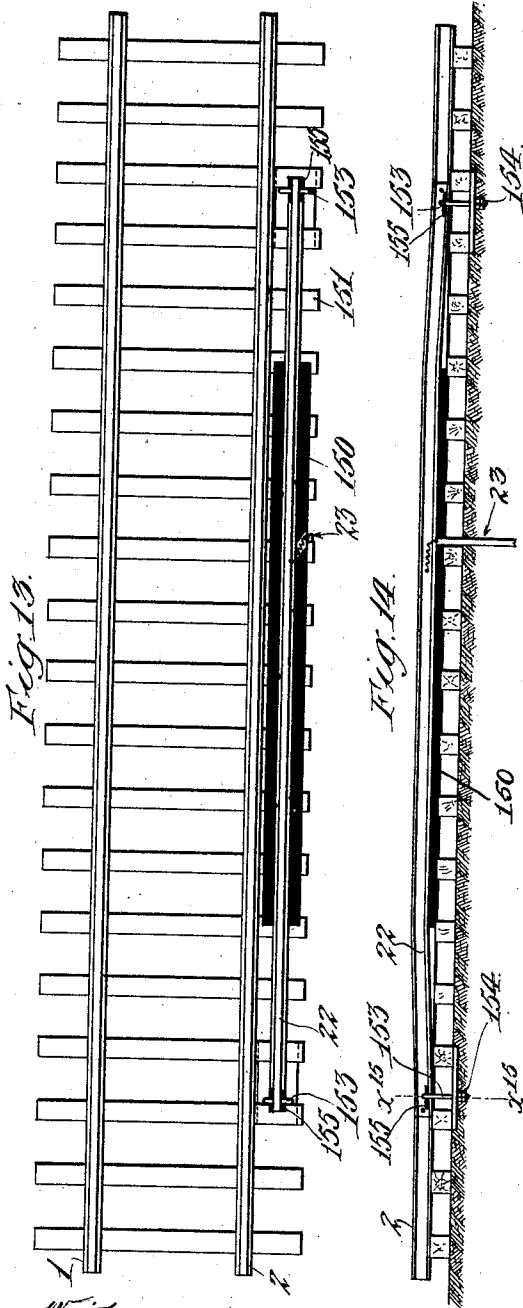
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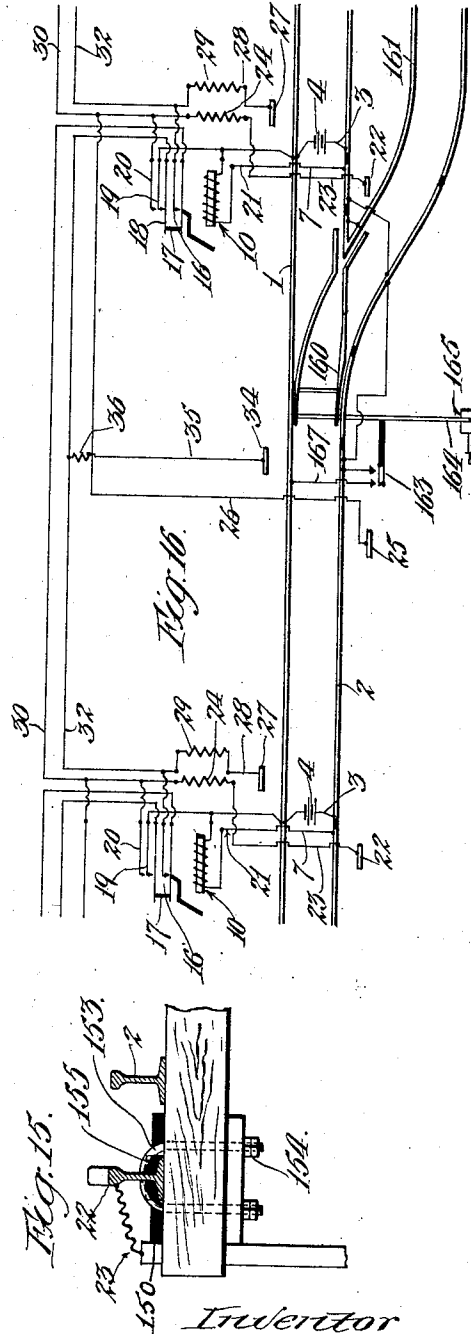
Patented May 13, 1913.

8 SHEETS-SHEET 8.



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UNITED STATES PATENT OFFICE.

WALTER D. NICKUM, OF LOS ANGELES, CALIFORNIA, ASSIGNOR TO RAILWAY SAFETY SIGNAL COMPANY, OF LOS ANGELES, CALIFORNIA, A CORPORATION OF CALIFORNIA.

RAILWAY SIGNAL SYSTEM.

1,061,863.

Specification of Letters Patent.

Patented May 13, 1913.

Application filed April 2, 1909, Serial No. 487,586. Renewed March 19, 1913. Serial No. 755,561.

To all whom it may concern:

Be it known that I, WALTER D. NICKUM, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Railway Signal System, of which the following is a specification.

The main object of the present invention is to provide a railway signal which will safeguard the operation of trains by producing in the cab of the engine, visual or audible signals, whereby the condition of the track ahead can at all times be determined by the engineer in the cab.

Other objects of the invention will appear hereinafter.

The accompanying drawings illustrate the invention.

Figure 1 is a diagram of the track circuits in normal condition when the track is cleared. Fig. 2 is a similar view showing the track circuits in operative condition, two trucks indicating trains being shown on the track and a complete circuit for one engine cab being shown. Fig. 3 is a diagram of the circuit connections for the engine relay. Fig. 4 is a plan of the engine relay. Fig. 5 is a side elevation of the engine relay. Fig. 6 is a vertical section of the engine relay, on the line x^6-x^6 in Fig. 5. Fig. 7 is a detail elevation of the engine relay contact means. Fig. 7^a is a perspective of a portion of a controlling lever in said contact means. Fig. 8 is a side view of the engine relay box, with parts broken away. Fig. 9 is a plan of the engine relay box. Fig. 10 is an inverted plan of the engine relay box. Fig. 11 is a front elevation of the engine relay signal box, with the outer door open. Fig. 12 is a diagram showing the connections for terminating a series of blocks. Fig. 13 is a plan of a portion of the track showing one of the insulated contact rails. Fig. 14 is a side elevation thereof. Fig. 15 is a transverse section on line $x^{15}-x^{15}$ in Fig. 14. Fig. 16 is a diagrammatic plan of a track switch and the signal circuits therefor.

Referring to Fig. 1 which shows the track circuits in connection with a single track railway, the track comprises a continuous rail 1 and a sectional rail 2 which is divided into blocks or sections, say, one mile in length, with insulation 3 between the sections, the blocks being marked A, B, C, D,

etc. At one end of each block or section a battery 4 is provided in a circuit 5, one side of said battery being connected to the end of the rail section 2 and the other side of the battery being connected to the continuous rail 1. At the other or farther end of each rail section a track relay 6 is provided, connected by a wire 7 to the said farther end of insulated track section 2 and connected by a wire 8 to the continuous rail 1. The relays 6 are primary track relays and are normally energized by current from the batteries 4. The operation which is to be performed by said relays requires, in general, more power than is available through an extended track rail circuit without undue waste of energy and I therefore employ, for each primary track relay, a secondary track relay 10 controlled by the primary track relay, said secondary track relay being included in a circuit 11, said circuit including also a local battery 12 and the armature and front contact of the relay 6, so that when the relay 6 is energized, the relay 10 is also energized. The armature 13 of relay 10 operates a plurality of circuit controlling contacts, formed, for example, as contact springs. A contact spring 15 is engaged or operated directly by the armature 13 to hold it in contact with a contact spring 16. Contact spring 15 is connected by an insulating mechanical connection 17 with a contact spring 18 normally in contact with the contact spring 19 which in turn is normally in contact with a contact spring 20. By "normally" is meant when the relay 10 is energized. When the armature 13 is released by the relay 10 it allows the aforesaid contact springs to move so that circuit is broken between contacts 15 and 16, between contacts 18 and 19, and between contacts 19 and 20.

The aforesaid contact spring 19 is connected by a wire 21 with the wire 8 leading from the primary track relay 6 to the continuous rail 1. The other contacts 15, 18 and 20 are connected to insulated contact rails or track contacts located alongside of the track at each side as follows: Considering the track with reference to a train traveling from left to right, as indicated by the arrow, at one end of each track section or block which will herein be termed the front end, and at the right hand side of the track, is provided an insulated contact

rail 22 connected by wire 23 through resistance 24 with the contact spring 20. A line wire 30 extends from spring contact 20 forwardly along the track to the contact spring 15 of the next relay in advance. Farther back on the same block, say half way back on the block, is provided an insulated contact rail 25 connected to a wire 26 extending alongside of the track and connected to the contact spring 20. At the rear end of the next following block and at the opposite side, that is, at the left hand side of the track, is provided an insulated contact rail 27 connected by wire 28 through resistance 29 with the contact spring 16 at this point. A line wire 32 also leads from the contact spring 16 at this point forwardly along the track to the next track relay in advance, where it is connected to the contact 18 controlled by said advance track relay. At intermediate points on the block, for example, at about half way along the block at the left hand side of the track is provided an insulated contact rail 34 connected through circuit 35 and resistance 36 to the line 32 of that block. The resistances 24, 29 and 36 are for the purpose of equalizing the resistance of lines 23, 28 and 35 with the resistance of line 26, as hereinafter set forth, bringing all of said lines to a given definite resistance, the operation of the engine relay being dependent in some respects on resistance of the line circuits.

The contact rails or track contacts may be of any suitable construction, for example, the form shown in Figs. 2 and 3 and Figs. 13 to 15, for the contact rail 22. The said contact rails are slightly higher than the track rails and are connected to the relays, as above described, by means of wires strung on poles. Said contact rails may consist of standard section railway rails of suitable length, mounted on brackets or other supports to give the required height. In the drawing a standard rail is shown for this purpose. The rail is preferably about sixty feet or more in length and is mounted on suitable insulating supports. The top of the contact rail may be about two inches above the main track rail which it parallels, the ends being gradually bent down so that at the end of the contact rail, the top of the head is level with the top of the main track rail. In Figs. 13 to 15 the contact rail 22 is shown as supported on a stringer 150 of insulating material secured to the ties 151, the end portions of the contact rail 22 being bent down as shown in Fig. 14 in proximity to rest on the ties and being held by U-shaped members 153 which pass through the ties and are secured by bolts 154, said contact rail being insulated from said U-shaped members by insulating blocks 155.

The apparatus and circuit connections in

the engine cab are shown diagrammatically in Fig. 3, and Fig. 2 illustrates the cooperation of this cab circuit and apparatus with the track circuit and apparatus. The function of the engine cab mechanism and circuits is to provide for visual and audible signals whereby the engineer is kept informed of the state of the track ahead. For this purpose two visual signals may be provided, for example, a green or safety lamp 41 and a red or danger lamp 42, and an audible signal 43 consisting of a bell may also be provided, these signal devices being connected to contact means controlled by a relay in the cab, herein termed the engine relay. Said relay comprises two coils 44, 45, preferably formed as solenoid coils, and controlling through their cores 46, 47, the operation of two lever devices 48, 49, operating on the contact means aforesaid, the stems 53, 57 of these cores sliding in guides 54, 54' on the base 55 of the device. Lever 48 is pivoted on a stud 50 extending from the base 55 and has a fork 51 engaging in a neck 52 formed in stem 53 of the solenoid core 46. Lever 49 is also pivoted on the stud 50, one arm of said lever extending through a slot 56 in stem 57 of solenoid core 47, the other arm of said lever 49 extending under the lever 48 and through a plunger 59 which slides through a guide 60 on the lever 48, a spring 62 being connected to these two levers 48, 49, so as to draw the last named arm of lever 49 upwardly toward the lever 48 and thereby cause the plunger 59 to be fully extended above the lever 48 in position to operate a contact spring 64 on a suitable insulating support 65 on the base 55. Plunger 59 has at its upper end an insulating tip 69, with a notch 69'. A contact spring 66, also mounted on said insulating support makes and breaks contact with the said spring 64 at one side thereof and on the other side of spring 64 is provided an insulated contact spring 67 and beyond the said contact spring 67 is provided a contact spring 68 so that when the contact spring 64 is pressed toward the right by elevation of the lever 48 and plunger 59, as shown in Fig. 3, the contact spring 64 will be removed from contact spring 66 and will close with contact spring 67 and force said spring 67 into contact with said contact spring 68. The solenoid core 46 operates under the influence of gravity in opposition to the coil 44. Solenoid core 47 in addition to the effect of gravity is controlled by the spring 70 tending to resist the elevation of the core by the solenoid coil, said spring being engaged by a pin 70' when the stem is fully raised. Stop screws 95, 96 are provided for core stems 53, 57. The circuits for the signal devices are further controlled by an auxiliary relay 71 formed preferably as a solenoid coil whose core 72

is mounted to slide by its stem 73 in a standard 74 on a base 55, said core having at its upper end a stem 76 provided with an insulating tip 77 to engage with a contact spring 78 to force the same into contact with a contact spring 79 when the relay coil 71 is energized. The solenoid coils 44, 45 are inclosed within tubular iron casings 80 with iron caps 81 at their upper ends having central lugs 82 extending downwardly within tubular brass sleeves 83 within the solenoid coils, iron screw caps 85 being screwed onto the lower ends of the casings 80 and perforated to receive the tubes 83 which serve as guides for the solenoid cores and are provided with fiber end pieces 86 to serve as bobbins for the coils; the complete solenoid thus built is retained in place by brass rings 87 secured on the base 55. The iron clad construction for the solenoids provides for maximum power of the solenoid for a given expenditure of current, and the core extensions of the iron heads close the magnetic circuit when the relay is operated, magnetically locking the relay in operated position. The auxiliary relay 71 is similarly formed with an iron jacket or casing 90 supported in rings 91 said casing being provided with iron heads 92, 93, the lower head being perforated for the reception of the brass bobbin tube 94 and the upper head having a downwardly extending central lug 97 perforated for the passage of the stem 76 aforesaid. The base 55 may be further provided with a connection board or series of contacts 99 for facilitating the connections between the various parts, as illustrated in Fig. 6.

The above described parts of the engine cab mechanism are preferably mounted in a casing or box, as shown in Figs. 8 to 11; said box has back member 100 and is provided with suitable means for attachment to a support in the cab. A box or receptacle 101 is attached to this back and contains the relay mechanism above described supported on the base 55 which is attached to the box 101 and a front box or casing 102 hinged at 104 to the back box 101 and containing the signal devices 41, 42, 43. The said signal devices 41, 42, may consist of two lamps mounted on partitions 107 in the front box 102, the front 108 of this front box being hinged at 109 and having openings 131, 132, at which are placed glass screens 110, 111, said screens being respectively of green and red glass, and being supported in frames 112. The magnet of the signal bell 43 may be attached to front 103, and when the front is closed may occupy the space between the partitions 107, the bell itself being outside of the front. Fastening means such as lugs 114, and hinges 115 adapted to receive fastening pins are provided at the opposite sides of the box from the hinges 104, 109 to enable the back

and front boxes to be fastened in closed position. Means indicated at 141 are provided for holding the lamps against vibration, and reflectors 142 are also provided for the lamps. The above described construction provides a compact device containing all the signal mechanism in one box and enabling access to any part of the signal mechanism on the opening of the front or back portion of the box as may be required.

The cab circuit is brought into coöperative relation with the track circuit by means of two brushes or contact devices 117, 118 mounted on and insulated from the truck 119 (see Fig. 2) of the engine and adapted to contact with the contact rails 22, etc., aforesaid, said brushes being so disposed that they will contact simultaneously with a contact rail during a limited time. The main battery 120 in the cab is connected at one side to wire 121 leading through solenoids 44, 45 to a wire 122 connected to the rear brush 117. The truck 119 is "grounded" by its contact with rail 1, and a connection 123 leads from the truck to the other side of battery, here termed the grounded side, so that the circuit for main signal relay 44, 45 is controlled by the connection between contact rail 22, etc., and the rail 1, which connection is in turn controlled by the track relays above described. This control of the signal circuit by the track circuits is limited as hereinafter explained to the times at which the engine truck brush 117 is in contact with a contact rail 22, 27, etc., in such manner that at each contact of the said brush with a contact rail, the track circuit of the next two blocks in advance is tested, as it were, by the signal battery and circuit, and if the track is clear the circuit of the engine battery is closed through the engine relay and a safety signal is given or maintained. To maintain this normal safety condition of the signal circuit while the engine is passing from one contact rail to the next, an auxiliary circuit and relay is provided, the wire 122 being connected by wire 124 to auxiliary relay 71, the connection being continued from said relay by wire 125 to the forward brush 118. The grounded side of the battery 120 is connected by wire 126 to the contact 64 aforesaid, and contacts 67, 66 are connected respectively by wires 128, 129 through the green signal lamp 41 and the red signal lamp 42 to a wire 130 leading to wire 121 connected to the other side of the battery, so that either the danger or the safety signal circuit is closed, according to whether the spring contact 64 is in contact with spring contact 66, or with spring contact 67. The audible signal or bell 43 is connected by a branch circuit 131 in parallel with the circuit through the red signal lamp. The contacts 78, 79 controlled by the auxiliary relay 71 are connected in a circuit 133 leading

from the wire 122 to the contact 68 aforesaid and including resistance 134. A manually operated key 135 is connected at its opposite sides respectively to the wires 126, 133, to establish a shunt when it is required to bring the cab circuit into normal condition. An auxiliary battery 136 is connected at one side through resistance 137 and wire 138 to the rear brush 117 and at the other side through resistance 139 and wire 140 to the forward brush 118.

The operation will now be described with reference to Fig. 1 showing the normal position of the track circuits when there is no train on the part of the track under consideration. From the track battery at the rear end of each block current passes through the track to the primary track relay at the forward end of the block, as follows: battery 4 through wire 5, insulated rail section 2, wire 7, relay 6, wire 8, continuous rail 1, and back to the other side of the battery. Each relay 6 being thus energized holds its armature in position to close the local circuit 11 from battery 12 through the secondary track relay 10, causing the armature of said relay to hold the contact 15 against contact 16 and through the insulated means 17 to hold the contacts 18, 19, and 20 in closed relation, the circuits from these contacts leading to the respective contact rails alongside of the track as above described. The contacts being closed, as stated, the line connections for each block are maintained in proper condition or held in readiness to cooperate with the cab circuit connections whenever an engine or train comes upon the block, it being understood that until this happens there is no current passing through the line connections 32, etc., these connections being energized only by a current from the engine cab as hereinafter described. Assume now that an engine has come on block B, namely, the second block with reference to the assumed direction indicated by an arrow, the engine indicated by the truck 119, the wheels and axle of the truck will close a short circuit between the sectional rail 2 of this block and the continuous rail 1, with the result that the battery 4 at the rear end of this block is short circuited through the truck, and the primary relay 6 at the forward end of the block will be deenergized, opening the local circuit 11 and deenergizing the second track relay 10, which releases its armature and allows the contacts controlled by this relay at the point or station between blocks B and C to move to the position shown in Fig. 2, in which they are all open circuited. As the engine passes over any one of the contact rails 22, etc., a circuit will be closed energizing or maintaining the energization of the engine relay; for example, if the engine is over contact rail 25, so that the brush

117 is in contact with said rail, current will proceed from the main battery 120 through wire 121, relay coils 44, 45, wire 122, brush 117, contact rail 25, line wire 26 of block B, line wire 30 of block C, to the relay at the forward end of block C, where it passes through contacts 15, 16, to line wire 32 of block D to relay at the forward end of block D, where it passes through contacts 18 to contact 19 and thence by wire 21 to continuous rail 1, a connection being completed from said rail through the truck of the engine and wire 123 to the grounded side of battery. The engine relay having been thus energized will hold its contacts in operative position, thereby establishing a safety signal circuit as follows: from battery 120, through wire 121, wire 130, visual safety signal or green lamp 41, wire 128, contact 67, contact 64, wire 126, to the grounded side of battery.

As the engine passes forward so as to remove the brush 117 from the contact rail the above described circuit is interrupted and the cab circuit is left under the control of the auxiliary relay and battery, the auxiliary battery energizing the auxiliary relay and the auxiliary relay maintaining a closed circuit for the engine relay independent of the track circuits. This position of the engine is represented by the position of the truck 119, shown in Fig. 2, the brushes 117, 118 being out of contact with any contact rail. Current will proceed from battery 136, through resistance 137 and wire 138 to brush 117, thence back by wires 122, 124 to auxiliary relay 71, thence by wire 125 to forward brush 118, from which the wire 140 leads through resistance 139 back to the other side of the auxiliary battery 136. The auxiliary relay 71 being thus energized holds its contacts 78, 79 closed so that current may pass from the main battery 120 to wire 121, relay coils 44, 45, wires 122, 124, contacts 78, 79, thence through resistance 134 and wire 133 to contact spring 68 which is connected through contact spring 67 to contact spring 64 connected to the grounded side of battery 120. The engine relay is thereby maintained in operative position, provided it was already in operative position before it came under the control of the auxiliary relay, it being noted that this circuit for the engine relay is controlled through the contacts 68, 67, 64, which are themselves controlled by the engine relay, so that the auxiliary circuit, above described, is not competent to itself operate the engine relay, but only to hold it in operative position when it has been operated by other means, for example, by the contact rail connection, as above described. This being the case, it is apparent that if a clear or safety signal was given when the engine was over the contact 25 such a signal will

be maintained after the engine leaves this contact and is passing forward to the next contact. Assume now that the engine reaches the contact rail 22 and that both brushes 117, 118 are on this contact rail. it will be noted that this produces a shunt circuit for the auxiliary battery 136, the current passing directly from one side of the battery through resistance 137, wire 138, brush 117, contact rail 22, brush 118, wire 140, resistance 139 to the other side of the battery. The auxiliary relay 71 being shunted, said relay allows contact 78, 79 to separate, thereby putting the engine relay solely under the control of the track circuit for the time being. Truck 119 being still on block B the track circuit still remaining as above described and as shown in Fig. 2, the current will pass from the battery 120 through the engine relay, as above traced, to brush 117, thence through contact rail 22, wire 23, resistance 24, line wire 30 of block C, to the relay at the forward end of said block where the connection is continued, as above described, through the contact springs 15, 16, to line wire 32 of block D, and thence by contacts 18, 19 and wire 21 to continuous rail 1 and back to the grounded side of the battery, as above described. It will be noted that this circuit includes a resistance 24 which is sufficient to prevent complete operation of the core of the solenoid 45 of the engine relay, so that the plunger 59 remains in uppermost position, being held in that position by the spring 62, and engine relay contacts are operated as above described. If, therefore, the track is clear in blocks C and D there is no change in the operation of the engine relay and the safety or green light signal is maintained in the cab, but if another engine has come onto the block D, for example, as indicated at 119', thereby shunting battery 4 of said block from the primary relay 6 at the forward end of said block and causing the contacts of the secondary relay to move to open position, as shown in Fig. 2; the circuit above traced for the engine relay of engine 119 is opened at the contacts 18, 19 of the track relay at the forward end of section D and, therefore, when the engine 119 passes on to contact 22 with the engine 119' in block D, the operating or maintaining circuit in the engine relay, above traced, is not closed, and the coils 44 and 45 will be deenergized, the lever 48 will fall, plunger 59 will be removed from contact spring 64, and the contacts 64, 67, 68 will open circuit, and contact 64 will close with contact 66, thereby establishing a danger signal circuit as follows: from battery 120, through wires 121, 130, lamp 42, wire 129, contacts 66, 64, to the other side of the battery, thus giving a visual danger signal, indicating that the track is not clear. At the same time bell 43 will be energized in ob-

vious manner, giving an audible signal. Similarly, if the truck or engine 119' should be in block C it would short circuit the relay at the forward end of said block, opening circuit between contacts 15, 16 of said relay, and thereby opening the circuit, above traced, of the engine battery and relay, causing the engine relay to release its armature and result in the production of a danger signal. On the other hand, in the event of a short circuit existing, for instance, between the contact rail 22, etc., and an adjacent rail, so that the current from the engine battery can pass to the adjacent rail 1 or 2 and engine trucks directly from wire 122, brush 117, contact rail 22, shorting medium to rail 1 or 2, trucks 119, wire 123 to battery 120, this connection cutting out resistance 24, so that the current passing through the engine relay is increased to such an extent that the solenoid coil 45 is effectively energized and will fully raise its core 47, thereby depressing the plunger 59 against the tension of spring 62, permitting the contact spring 64 to snap into notch 69 in the top of the plunger and allowing said contact spring to move into contact with the contact spring 66, establishing the danger signal circuit, as above described.

As both the solenoids 44 and 45 would remain energized and lock their cores 46 and 47 as long as the contact member 117 is on the contact 22 of the outside circuit, the locking device caused by the hook 64' of contact spring 64 engaging the groove 69' of the plunger 59 is provided, so that in the event of the shunt on the outside circuit being of sufficiently high resistance to not properly lock the core 47 with the lug 82 in the cap 81 in the end of the solenoid 45, and a sudden jar or jolt breaking it away, it could not by dropping again cause the plunger to press the contact spring 64 into contact with contact springs 67, 68. As soon as the contact member 117 leaves the contact 22 of the outside circuit, the core 47 of the solenoid 45 will drop (as the local circuit is open between contact springs 67, 68 and 64) taking with it the lever 49 and will release the groove 69' in the end of plunger 59 from the hook 64' of the contact spring 64. The spring 62 between the arms 49 and 48 again draws the end of arm 49 up against the bottom of arm 48 and lifts the plunger 59 back into its normal position, so that when the core 47 is again lifted into the solenoid 45, the plunger 59 will press against contact springs 64 and cause it to make its normal contact with contact springs 67, 68.

When the truck or engine 119 is traveling in the direction of the arrow and carrying the circuits and equipment above described and the brushes 117 and 118, it is evident that when the brush 117 comes into

contact with any of the contact rails 22 the condition of the track for two blocks ahead will be given by the main relay showing either the clear or danger indication. Also
 5 when the brush 117 is in contact with any of the contact rails 25, the condition of the track will be given for two and one-half blocks ahead. It is also evident that if the direction of the trucks are reversed so that
 10 they are moving oppositely to the direction of the arrow, the brush 117 then being on the other side of the trucks so as to make contact with the contact rails 27 and 34 of the various blocks, then when the brush 117
 15 is on the contact rail 27 the condition of the track for two blocks ahead will be given, while if the brush 117 is on a contact rail 34 the condition of the track will be given for two and one-half blocks ahead. The con-
 20 nection from contact 25 through the line 26 is continued through lines 30 and 32, finding operative connection to the continuous rail after passing two and one-half blocks, an operative circuit for this contact being
 25 established as soon as a relay two and one-half blocks away is operated. The connection for the contact 34 through line 35 is normally opened between contact 18 and 19 and as this line has no connection to the
 30 next section, otherwise than the single contacts, it can only be brought into operation when the train comes up within one-half block of the contact 34. For this reason the resistance 36 is inserted to equalize the con-
 35 ditions in the engine relay which, as above stated, is responsive to different strengths of current to operate in different manner, and which, therefore, requires definite circuit re-
 40 sistance for uniform operation on the different contacts.

From the foregoing description of the operation of the track circuits and equipment in conjunction with the engine circuits and equipment, it is evident from the way in
 45 which the track batteries 4 control the track relays 6 that any condition which will cut off the current of the track batteries 4 from the track relays will cause the danger indication to be given to the engine equipment.
 50 When the trucks of a car or engine are within the limits of any given block the wheels and axles of said trucks short circuit the track rails 1 and 2, thereby shunting the current of the battery 4 from the relays 6.
 55 If a break should occur in either of the track rails 1 or 2 it would open the circuit between the battery 4 and the relay 6, also giving the danger indication to the engine equipment, and by means of proper insulation, suitably placed and the use of a switch whereby the track rails 1 and 2 can be short
 60 circuited thereby shunting the battery 4 from the relay 6, a switch to a siding can be so equipped that if the switch is open or if
 65 a car is within the danger or fouling limits

of the main line the danger indication will be given as above. Such construction is illustrated in Fig. 16.

160 designates the track switch leading to a turn-out or siding 161, the main track 1, 2 being provided with track relays and circuits as above described, and a switch 163 being provided operated by a mechanical connection 164 with the operating means 165 for the track switch, said switch 163 controlling a short circuit 167 between the continuous rail 1 and a rail section 2 in advance of the switch, so that if the switch is closed as shown in Fig. 16 an approaching train will be signaled in the same manner as above described in case a train is already on the next section.

In the event of a danger indication being given to the engine equipment and it is desired to restore the apparatus to the normal or clear position before a contact rail having a complete line circuit with the track rail is reached, the clear indication can be restored by depressing the key 135 thus completing a circuit as follows: From battery 120, wire 121, coils 44, 45, wire 122, wire 124, through contact springs 78, 79, resistance 134, 133, key 135 and wire 126 to battery 120, thus energizing the coil 44 and lifting the core 46, bringing the plunger 59 against the contact spring 64, thereby causing contact spring 64 to make contact with contact springs 67 and 68 and completing the normal local circuit from the battery 120 through the coil 44, contacts 78, 79, resistance 134 and contacts 64, 67, 68 back to battery 120, and also breaking the contacts between contact springs 64, 66, thus cutting out the red light 41 and bell 43 and restoring the circuit through the green light 42.

At each end of the railway or of the series of blocks thereof it is necessary to arrange the connections so as to complete the line circuits notwithstanding the absence of a preceding or succeeding block. For this purpose the terminal blocks may be arranged as shown in Fig. 12, in which, for simplicity the primary relay 6 is omitted, the relay 10 being connected directly to the track circuit. In the relay for the initial block A, the contact 18 is without line connection, as there is no line 32 leading from the relay to the preceding relay. In the relay for the second block B, the line wire 35 is connected to line wire 30, instead of to line wire 32. In the following blocks the connections may be as shown in block X. In the next to the last block Y, the line 26 is connected to contact 16 instead of to contact 20, and in the last block Z there is no line wire 26, and the line wire 32 is connected to contact 20 thus closing the connection for the preceding block.

What I claim is:—

1. In an electric railway signal, the com- 130

5 bination with track rails, one of which is
a continuous rail, a vehicle traveling on said
track rails, and insulated contacts along the
track, of signal apparatus on said vehicle
comprising a battery, a conductor connected
to one side of the battery, a relay having its
coil connected at one side to said conductor,
a conductor connected to the other side of
said relay, a brush connected to said second
conductor and adapted for contact with said
insulated contacts along the track, a con-
ductor connected to the other side of the
battery and grounded to the vehicle wheels
for connection with said continuous rail
of the track, a danger signal controlled by
said relay and auxiliary means for main-
taining energizing connection for said relay
when the said brush is off of said contacts,
said auxiliary means comprising an aux-
iliary relay and battery, conductors con-
necting said auxiliary relay and battery,
and an auxiliary energizing connection from
the first named battery to the first named re-
lay including contact means controlled by
said auxiliary relay.

2. In an electric railway signal, the com-
bination with track rails, one of which is a
continuous rail, a vehicle traveling on said
track rails, and insulated contacts along the
track, of signal apparatus on said vehicle
comprising a battery, a conductor connected
to one side of the battery, a relay having
its coil connected at one side to said con-
ductor, a conductor connected to the other
side of said relay, a brush connected to said
second conductor and adapted for contact
with said insulated contacts along the track,
a conductor connected to the other side of
the battery and grounded to the vehicle
wheels for connection with said continuous
rail of the track, a danger signal controlled
by said relay and auxiliary means for
maintaining energizing connection for said
relay when the said brush is off of said
contacts, said auxiliary means comprising
an auxiliary relay and battery, conduc-
tors connecting said auxiliary relay and
battery, and an auxiliary energizing con-
nection from the first named battery to the
first named relay, including contact means
controlled by said auxiliary relay, and a
second brush also adapted to contact with
said insulated track contact, said two
brushes being connected to opposite sides of
the auxiliary battery to short circuit the
auxiliary relay when both of said brushes
are on one contact.

3. In an electric railway signal, the com-
bination with track rails, one of which is a
continuous rail, a vehicle traveling on said
track rails, and insulated contacts along the
track, of signal apparatus on said vehicle
comprising a battery, a conductor connected
to one side of the battery, a relay having
its coil connected to said conductor at one

side of the relay, a conductor connected to
the other side of said relay, a brush con-
nected to said second conductor and adapted
for contact with said insulated contacts
along the track, a conductor connected to
the other side of the battery and to the ve-
hicle wheels for connection with said con-
tinuous rail of the track, and auxiliary
means for maintaining energizing connec-
tion for said relay when the said brush is
off of said contacts, said auxiliary means
comprising an auxiliary relay and battery,
conductors connected to said auxiliary re-
lay and battery, an auxiliary energizing
connection for the first named relay includ-
ing contact means controlled by said auxil-
iary relay, and a second brush also adapted
to contact with said insulated track con-
tact, said two brushes being connected to
opposite sides of the auxiliary battery to
short circuit the auxiliary relay when both
of said brushes are on one contact, a con-
tact means in said auxiliary energizing con-
nection controlled by said first named relay
and closed on energization of said relay, a
safety signal means, and connections there-
from to aforesaid conductors leading to op-
posite sides of the first named battery, said
connections for the safety signal including
contact means controlled by the first named
relay, and closed by energization of said
relay, a danger signal, a conductor connect-
ed to said danger signal and to the first
named battery, and contacts in the last
named conductor controlled by said first
named relay and closed when said relay is
deenergized.

4. In an electric railway signal, the com-
bination with track rails, one of which is a
continuous rail, a vehicle traveling on said
track rails, and insulated contacts along the
track, of signal apparatus on said vehicle
comprising a battery, a conductor connect-
ed to one side of the battery, a relay having
its coil connected to said conductor at one
side of the relay, a conductor connected to
the other side of said relay, a brush connect-
ed to said second conductor and adapted for
contact with said insulated contacts along
the track, a conductor connected to the other
side of the battery and to the vehicle wheels
for connection with said continuous rail of
the track, and auxiliary means for main-
taining energizing connection for said re-
lay when the said brush is off of said con-
tacts, said auxiliary means comprising an
auxiliary relay and battery, conductors con-
nected to said auxiliary relay and battery,
an auxiliary energizing connection for the
first named relay including contact means
controlled by said auxiliary relay, and a sec-
ond brush also adapted to contact with said
insulated track contact, said two brushes
being connected to opposite sides of the aux-
iliary battery to short circuit the auxiliary

relay when both of said brushes are on one contact, a contact means in said auxiliary energizing connection controlled by said first named relay and closed on energization
 5 of said relay, a safety signal means, and connections therefrom to aforesaid conductors leading to opposite sides of the first named battery, said connections for the safety signal including contact means controlled by the first named relay, and closed
 10 by energization of said relay, a danger signal and a conductor connected to said danger signal and to the first named battery and contacts in the last named conductor controlled by said first named relay and
 15 closed when said relay is deenergized, an additional coil connected in the circuit of the aforesaid coil of the first named relay, and means operated by said additional coil on excessive current therein and controlling
 20 the aforesaid contact means controlled by said first named relay to close the circuit for the danger signal and open the circuit for the safety signal upon such occurrence of excessive current.
 25

5. In an electric railway signal, the combination with track rails, one of which is a continuous rail, a vehicle traveling on said track rails, and insulated contacts along the
 30 track, of signal apparatus on said vehicle comprising a battery, a conductor connected to one side of the battery, a relay having its coil connected to said conductor at one side of the relay, a conductor connected to the
 35 other side of said relay, a brush connected to said second conductor and adapted for contact with said insulated contacts along the track, a conductor connected to the other side of the battery and to the vehicle wheel
 40 for connection with said continuous rail of the track, and auxiliary means for maintaining energizing connection for said relay when the said brush is off of said contacts, said auxiliary means comprising an auxil-

iary relay and battery, conductors connecting said auxiliary relay and battery, an auxiliary energizing connection for the first named relay including contact means controlled by said auxiliary relay, and a second
 50 brush also adapted to contact with said insulated track contact, said two brushes being connected to opposite sides of the auxiliary battery to short circuit the auxiliary relay when both of said brushes are on one
 55 contact, a contact means in said auxiliary energizing connection controlled by said first named relay and closed on energization of said relay, a signal means controlled by the first named relay, and a connection including a manually operated switch for
 60 establishing a connection from the first named relay to the return side of the battery independent of the aforesaid brush connected to said relay for the purposes set forth.
 65

6. In an electric railway signal, a signal lamp, a battery, connections from said battery to said lamp including contact means, a magnetic device controlling said contact means and provided with an operating coil,
 70 connections from said battery to said coil and means for making and breaking said connections, and an auxiliary energizing connection from said battery to said coil, contact means included in said auxiliary
 75 energizing connection, an auxiliary relay controlling said last named contact means, an auxiliary battery connected to said auxiliary relay, and means for short circuiting the connection from said auxiliary battery
 80 to deenergize said auxiliary relay.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 26th of March 1909.

WALTER D. NICKUM.

In presence of—

FRANK L. A. GRAHAM,
 G. T. HACKLEY.