May 17, 1932. S. M. LUCAS 1,858,897

RAILWAY SWITCH CONTROLLING APPARATUS

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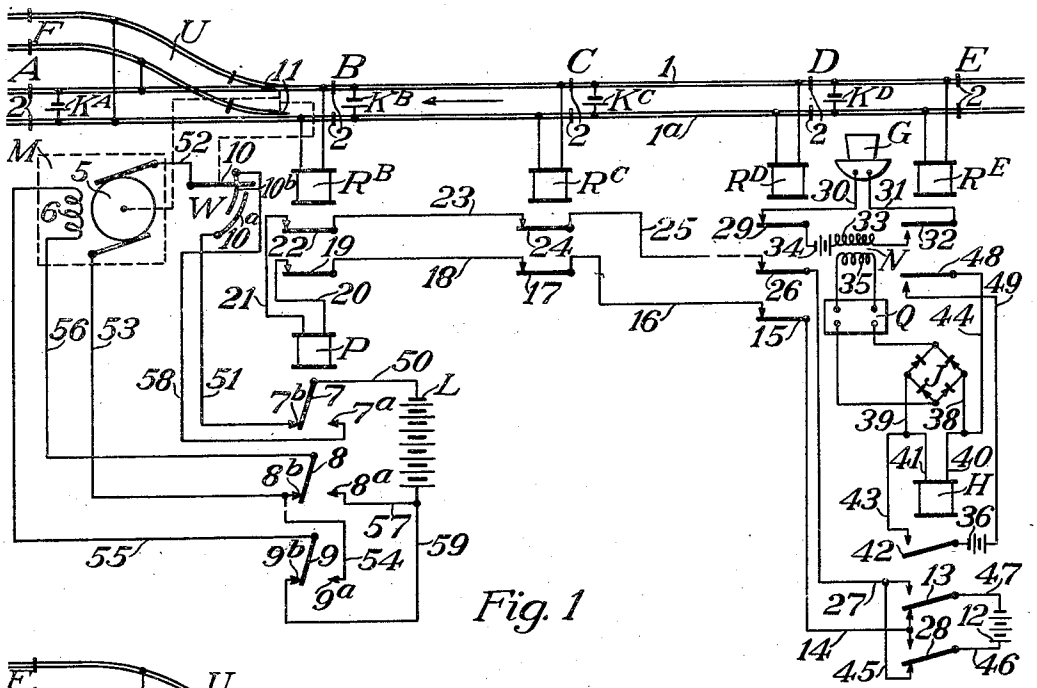


Fig. 1

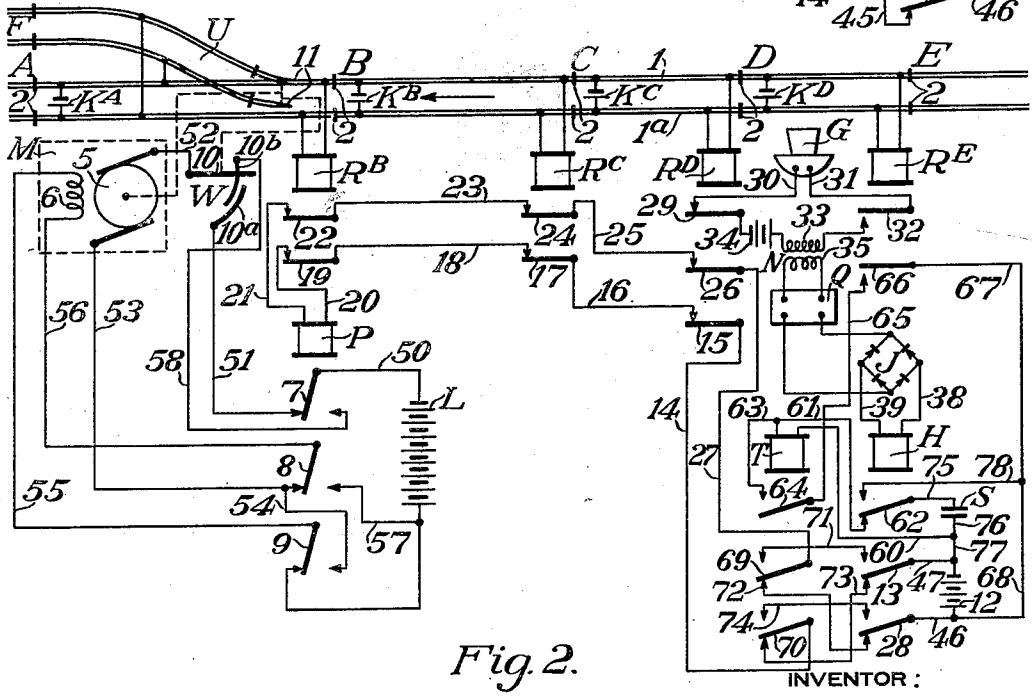


Fig. 2.

INVENTOR:
S. M. Lucas,
by A. R. Vernill,
His Attorney

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UNITED STATES PATENT OFFICE

SAMUEL M. LUCAS, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

RAILWAY SWITCH CONTROLLING APPARATUS

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My invention relates to railway switch controlling apparatus, and particularly to apparatus of the type comprising means located on a train and co-operating with means located in the trackway for operating a railway switch.

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

In the accompanying drawings, Fig. 1 is a diagrammatic view showing one form of railway switch controlling apparatus embodying my invention. Fig. 2 is a similar view showing a modified form of the apparatus illustrated in Fig. 1, and also embodying my invention.

Similar reference characters refer to similar parts in both views.

Referring first to Fig. 1, the reference characters 1 and 1^a designate the track rails of a stretch of railway track over which traffic normally moves in the direction indicated by the arrow. These rails are divided, by means of insulated joints 2, into successive track sections A—B, B—C, C—D, D—E, etc. Each such track section is provided with a source of track circuit current here shown as a track battery designated by the reference character K with an exponent corresponding to the location, which battery is connected across the rails adjacent the exit end of the section. Each track section is also provided with a track relay designated by the reference character R with an exponent corresponding to the location, and connected across the rails adjacent the entrance end of the section.

Section A—B is provided with a switch 11 for allowing traffic to proceed onto a siding U or to continue on the main track through section A—B, depending upon the position of the switch. The portion of siding U to the right of fouling point F is included in the track circuit for the section to the right of point A in the usual and well known manner. The switch 11 is operated by a motor M which, as here shown, comprises an armature 5 and a field winding 6. This motor is controlled by a polarized relay P, which is of the two-position permanent magnet type, and which is provided with polar contact fingers 7, 8 and 9. The switch 11 operates a circuit controller W comprising a contact $10—10^a$ which is closed at all times except when switch 11 occupies its normal position, and a contact $10—10^b$ which is closed at all times except when switch 11 occupies its reverse position. If relay P is reversed, so that polar contact fingers 7, 8 and 9 are swung to the right, motor M is supplied with current from a battery L, through wire 50, contact $7—7^a$ of relay P, wire 58, contact $10—10^b$ of circuit controller W, wire 52, armature 5 of motor M, wires 53 and 54, contact $9—9^a$ of relay P, wire 55, field winding 6 of motor M, wire 56, contact $8—8^a$ of relay P, and wire 57 back to battery L. Motor M then reverses switch 11. When switch 11 reaches its full reverse position, contact $10—10^b$ opens, thereby de-energizing motor M. If, now, relay P is energized in the normal direction so that polar contact fingers 7, 8 and 9 are swung to the left-hand positions in which they are shown in the drawings, current flows from battery L through wire 50, contact $7—7^b$ of relay P, wire 51, contact $10—10^a$ of circuit controller W, wire 52, armature 5 of motor M, wire 53, contact $8—8^b$ of relay P, and wire 56, field winding 6 of motor M, wire 55, contact $9—9^b$ of relay P, and wire 59 back to battery L. Motor M therefore returns switch 11 to the normal position. As soon as the motion of switch 11 is completed, contact $10—10^a$ opens and contact $10—10^b$ closes, so that the parts are restored to the positions in which they are shown in the drawings.

The supply of energy to relay P is controlled by track relays R^B, R^C, and R^D, and also by an auxiliary relay H, the contacts 13 and 28 of which constitute a pole-changer to reverse the polarity of the current supplied to relay P. When relay H is de-energized, and when track relays R^B, R^C and R^D are all energized, relay P is supplied with current of what I shall term "normal" polarity over a circuit which passes from a battery 12, through wire 47, back contact 13 of relay H, wire 14, front contact 15 of track relay R^D, wire 16, front contact 17 of track

relay R^C, wire 18, front contact 19 of track relay R^B, wire 20, winding of relay P, wire 21, front contact 22 of track relay R^B, wire 23, front contact 24 of track relay R^C, wire 25, front contact 26 of track relay R^D, wires 27 and 45, back contact 28 of relay H, and wire 46 back to battery 12. Under these conditions, polar contact fingers 7, 8 and 9 of relay P occupy the positions in which they are shown in the drawings. When relay H is energized, and when track relays R^B, R^C and R^D are all energized, relay P is supplied with current of what I shall term "reverse" polarity over a circuit which passes from battery 12, through wire 47, front contact 13 of relay H, wire 27, front contact 26 of track relay R^D, wire 25, front contact 24 of track relay R^C, wire 23, front contact 22 of track relay R^B, wire 21, winding of relay P, wire 20, front contact 19 of track relay R^B, wire 18, front contact 17 of track relay R^C, wire 16, front contact 15 of track relay R^D, wire 14, front contact 28 of relay H, and wire 46 back to battery 12. Under these conditions, the polar contact fingers 7, 8 and 9 of relay P are swung to the right. When one or more of relays R^B, R^C or R^D is de-energized, both circuits for relay P are open, and under these conditions, since relay P is of the permanent magnet type, the polar contact fingers 7, 8 and 9 of relay P will remain in the positions to which they were last moved, but the relay cannot be operated.

Relay H is controlled by a sound responsive device here shown as a microphone G located adjacent the trackway. As here shown, the microphone is located adjacent the exit end of section D—E. Microphone G is at times supplied with current from a battery 34, through front contact 29 of track relay R^D, wire 30, microphone G, wire 31, back contact 32 of track relay R^E, and the primary 33 of a transformer N back to battery 34. This circuit is closed only when track relay R^D is energized and when track relay R^E is de-energized, under which conditions constant unidirectional current from battery 34 normally flows in the circuit. If sound waves are transmitted to microphone G, under these conditions, however, the current flowing in the microphone circuit is varied by the variations in the resistance of microphone G, and an alternating electromotive force is induced in the secondary 35 of transformer N, the frequency of which electromotive force depends upon the frequency of the second waves transmitted to microphone G. The secondary 35 of transformer N is connected with relay H through a filter Q and a rectifier J, and when an electromotive force is induced in secondary 35 of transformer N, relay H is supplied with current. The function of filter Q will be explained more fully hereinafter. Relay H is also provided with a stick circuit which passes from a battery 36, through a front contact 42 of relay H, wires 43 and 41, winding of relay H, wires 40 and 44, back contact 48 of track relay R^E, and wire 49 back to battery 36.

Switch 11 is intended to be operated when sound waves of a particular character, such, for example, as those emitted by a train whistle, are transmitted to microphone G. It is therefore desirable to prevent relay H from becoming energized when extraneous sound waves, such as train noises are transmitted to microphone G. This result may be accomplished by designing filter Q in such manner that the filter will pass only currents having frequencies corresponding to the frequency of the particular sound waves to which the apparatus is intended to respond. Furthermore, section D—E may be made comparatively short, say 100 or 200 feet. Since the circuit for microphone G is controlled by the back contact of the track relay for this section, and the front contact of the track relay for section C—D, the circuit for microphone G will be closed only during the comparatively short interval of time which is required for a train to pass through section D—E into section C—D, and it will be apparent that the possibility of operation of the apparatus due to undesirable sound waves transmitted to microphone G is therefore limited to this short interval of time.

As shown in the drawings, sections A—B, B—C, C—D, and D—E are all unoccupied, track relays R^B, R^C, R^D, and R^E are all energized, relay H is de-energized, and relay P is supplied with current of normal relative polarity so that switch 11 occupies its normal position so that traffic can proceed along the main track through section A—B. I will assume that filter Q has been designed so that the trackway apparatus will function only when sound waves from a train whistle are transmitted to microphone G, and I will also assume that a train enters section D—E. When the train enters the section, track relay R^E becomes de-energized, thereby closing the circuit for microphone G, and the primary 33 of transformer N, at back contact 32 of the relay. If the engineman wishes to proceed on the main track through section A—B past switch 11, he does not operate the train whistle, and relay H remains de-energized, so that switch 11 remains in the position shown in the drawings. When the train enters section C—D, track relay R^D is de-energized, and as the train proceeds through sections B—C and A—B, track relays R^C and R^B are subsequently de-energized. Each of these track relays opens the circuit for relay P, and when the circuit for relay P is open, the polar contact fingers of relay P remain in the positions which they then occupy, and it is impossible for motor M to be reversed, and hence impossible to operate switch 11, while the train is between points D and A.

If the engineman wishes to reverse switch 11, he operates the whistle on the train while the train is in section D—E. As a result, sound waves from the train whistle are transmitted to microphone G, which sound waves cause an electromotive force to be induced in secondary 35 of transformer N. This electromotive causes relay H to pick up. When relay H is once picked up it is subsequently held up over its stick circuit as long as track relay R^E is de-energized. Current of reverse polarity is then supplied to relay P, which reverses its contacts, thereby causing switch 11 to be reversed to set up the route into track U. When the train leaves section D—E, the energization of track relay R^E opens the stick circuit for relay H so that relay H becomes de-energized, but this is not effective to restore switch 11 to its normal position since the circuit for relay P is now open at front contacts 15 and 26 of track relay R^D, and when the circuit for relay P is open, the polar contact fingers of the relay remain in the positions to which they were last moved. For a similar reason, the switch cannot be restored to its normal position while the train is in sections B—C or A—B. When the train passes the fouling point F of track U, however, the resultant energization of track relay R^B completes the normal circuit for relay P, which automatically restores the switch to its normal position.

Referring now to Fig. 2, the apparatus here illustrated is similar to that shown in Fig. 1, except that the stick circuit for relay H has been omitted, and a stick relay T and a condenser S, have been added. When relay H is energized, condenser S is included in a charging circuit which passes from battery 12 through wires 77 and 76, condenser S, front contact 62 of relay H, and wires 78 and 68 back to battery 12. When this circuit is closed, condenser S is charged to the potential of battery 12. If, now, relay H becomes de-energized, condenser S is included in a pick-up circuit for relay T, which circuit may be traced from the lower plate of condenser S through wires 76 and 60, winding of relay T, wire 61, back contact 62 of relay H, and wire 75 back to the upper plate of condenser S. Relay T then becomes energized by current flowing in this circuit due to the discharge of condenser S, and if relay R^E is de-energized, relay T is subsequently held in its energized condition by virtue of a stick circuit which passes from battery 12, through wires 77 and 60, winding of relay T, wire 63, front contact 64 of relay T, wire 65, back contact 66 of track relay R^E, and wires 67 and 68 back to battery 12.

The contacts 69 and 70 of relay T are included in the control circuit for relay P. As shown in the drawings, relays T and H are both de-energized, under which conditions the circuit for relay P passes from battery 12 through wire 47, back contact 13 of relay H, wire 73, back contact 70 of relay T, wire 14, and thence as in Fig. 1 through the winding of relay P and wire 27, back contact 69 of relay T, wire 72, back contact 28 of relay H, and wire 46 back to battery 12. When relays H and T are both energized, however, the circuit for relay P passes from battery 12, through wire 47, front contact 13 of relay H, wire 71, front contact 69 of relay T, wire 27, and thence as in Fig. 1, through the winding of relay P and through wire 14, front contact 70 of relay T, wire 74, front contact 28 of relay H, and wire 46 back to battery 12. It will therefore be apparent that if track relays R^B, R^C and R^D are all energized, relay P is supplied with current of normal or reverse polarity according as relays T and H are both energized or are both de-energized.

In explaining the operation of the apparatus shown in Fig. 2, I will assume as in Fig. 1, that the apparatus has been designed to respond to sound waves emitted by a train whistle. When the train enters section D—E, if the engineman wishes to proceed on the main track, through section A—B, he does not operate the train whistle, and relays H and T both remain de-energized, so that relay P continues to be supplied with current of normal polarity as the train proceeds through section D—E, and switch 11 remains in the position in which it is shown in the drawings. The train may then proceed on the main track past switch 11, and the remainder of the apparatus functions in the manner already described in connection with Fig. 1.

If the engineman desires to reverse switch 11, however, he must now give two blasts of the train whistle, while the train is in section D—E. The first blast of the train whistle causes relay H to pick up, as in Fig. 1, but this relay H becomes de-energized as soon as the first blast of the whistle has ceased. While relay H is energized, however, condenser S is charged from battery 12, and when the relay drops, condenser S is then discharged through relay T, which discharge picks up relay T. Relay T then remains energized by virtue of its stick circuit, since track relay R^E is deenergized. The second blast of the train whistle again picks up relay H, and since relays T and H are now both energized, relay P is supplied with current of reverse polarity, so that relay P reverses its contacts, thereby causing switch 11 to be reversed. It will be seen, therefore, that with the apparatus illustrated in Fig. 2, the switch can be operated only by whistle signals of a predetermined combination or code. By suitable adjustments of the parts the apparatus might be made responsive to other codes than the two blasts here required. When the second blast of the whistle ceases, relay H again becomes de-energized, but relay P remains in its reverse position to com-

plete the reversal of switch 11. When the train has passed out of section D—E, the energization of track relay R^E de-energizes relay T, but switch 11 can not be restored to its normal position until after the train has passed fouling point F because while the train is between points F and D the circuit for relay P is open at the contacts of track relays R^D, R^C or R^B, depending upon which section the train occupies. After the train has passed point F, however, the circuit for relay P is closed by the energization of track relay R^B, and since relays H and T are now both de-energized, relay P is energized by current of normal polarity, and switch 11 is restored to its normal position.

Although I have herein shown and described only two forms of railway switch controlling 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 combination, a railway switch, a relay, a motor controlled by said relay for operating said switch, and means located adjacent the trackway and responsive to sound waves of a particular character transmitted from a train approaching said switch for at times operating said relay.

2. In combination, a stretch of railway track provided with a switch, a first relay, a motor controlled by said first relay for operating said switch, a sound responsive device located adjacent the trackway, and a second relay controlled by said sound responsive device for at times controlling said first relay.

3. In combination, a stretch of railway track provided with a switch, a first relay, a motor controlled by said relay for operating said switch, an auxiliary relay for operating said first relay, a microphone located adjacent the trackway, and means controlled by said microphone for operating said auxiliary relay.

4. In combination, a stretch of railway track containing a switch, mechanism responsive to reversals of the relative polarity of the current supplied thereto for operating said switch, a relay, means controlled by said relay for supplying said mechanism with current of one relative polarity or the other, a microphone located adjacent the trackway in rear of said switch, a transformer, a circuit including said microphone and the primary of said transformer, and means for supplying energy from the secondary of said transformer to said relay.

5. In combination, a stretch of railway track provided with a switch, a first relay, a motor controlled by said first relay for operating said switch, an auxiliary relay for controlling said first relay, a track relay for said stretch, a microphone located adjacent the trackway in rear of said switch, a circuit for said microphone including a back contact of said track relay, and means for supplying said auxiliary relay with energy from said circuit when sound waves of a particular character are transmitted to said microphone.

6. In combination, a first and a second section of railway track, a railway switch located in advance of said two sections, a track relay for each said section, a microphone located adjacent the trackway, a source of unidirectional current, a transformer; a circuit for the primary of said transformer including said microphone, said source, a front contact of the track relay for the second section and a back contact of the track relay for the first section; an auxiliary relay connected with the secondary of said transformer, a filter interposed between said auxiliary relay and the secondary of said transformer and designed to pass only currents of particular frequencies, and means controlled by said auxiliary relay for actuating said switch.

7. In combination, a stretch of railway track containing a switch, a microphone for said stretch located adjacent the trackway in the rear of said switch, a first relay controlled by said microphone, a second relay controlled by said first relay, a motor responsive to reversals in the polarity of the current supplied thereto for operating said switch, and means for supplying said motor with current of one polarity when said first and second relays are both energized and for supplying said motor with current of the other polarity when said first and second relays are both de-energized.

8. In combination, a stretch of railway track containing a switch, a microphone located adjacent the trackway, a first relay controlled by said microphone, a condenser, means for charging said condenser when said first relay is de-energized, a second relay, means for discharging said condenser through said second relay when the first relay is energized, a motor responsive to the polarity of the current supplied thereto for operating said switch, and means for supplying said motor with current of one polarity when said first and second relays are both energized and for supplying said motor with current of the opposite polarity when said first and second relays are both de-energized.

9. In combination, a stretch of railway track containing a switch, a microphone located adjacent the trackway, a first relay controlled by said microphone, a second relay controlled by said first relay, a polarized relay, means for supplying said polarized relay with current of one polarity when said first and second relays are both energized and for supplying said polarized relay with cur-

rent of the opposite polarity when said first and second relays are both deenergized, and means controlled by said polarized relay for actuating said switch.

10. In combination, a stretch of railway track containing a switch, a track relay for said stretch, a microphone located adjacent the trackway in rear of said switch, a source of unidirectional current, a transformer; a circuit including said microphone, a back contact of said track relay, the primary of said transformer, and said source; a filter, an auxiliary relay connected with the secondary of said transformer through said filter, a condenser, a second source of unidirectional current, a charging circuit for said condenser including said second source and a front contact of said auxiliary relay, a stick relay, a pick-up circuit for said stick relay including said condenser and a back contact of said auxiliary relay, a stick circuit for said stick relay including a back contact of said track relay, a motor for controlling said switch in accordance with the polarity of the current supplied thereto, and means for supplying said motor with current of one relative polarity when said stick relay and said auxiliary relay are both de-energized and for supplying said motor with current of the other relative polarity when said stick relay and said auxiliary relay are both energized.

11. In combination, a first and a second section of railway track, a track relay for each said section, a railway switch located in advance of said two sections, a microphone located adjacent the trackway, a source of unidirectional current, a transformer; a circuit including said source, a front contact of the track relay of the second section, said microphone, a back contact of the track relay for the first section, and the primary of said transformer; a filter, an auxiliary relay connected with the secondary of said transformer through said filter, a condenser, means for charging said condenser when said auxiliary relay is energized, a stick relay, means for discharging said condenser through said stick relay when said auxiliary relay subsequently becomes de-energized, a stick circuit for said stick relay including a back contact of the track relay for said first section, a polarized relay, means for supplying said polarized relay with current of one polarity when the track relay for said second section is energized and when said stick relay and said auxiliary relay are both energized and for supplying said polarized relay with current of the opposite polarity when the track relay for the second section is energized and said stick relay and said auxiliary relay are both de-energized, and means controlled by said polarized relay for controlling said switch.

12. In combination, a stretch of railway track containing a switch, a polarized relay, means for moving said switch to one position or the other according as said relay is energized by current of one polarity or the other, said relay remaining in the position to which it was last operated until the relay is positively reversed, a normal circuit supplying said relay with current of one polarity, a microphone located in the trackway for operation by sound waves originating on a train approaching said switch, means controlled by said microphone for supplying current of the opposite polarity to said polarized relay, and means for holding said normal circuit open until the train has passed the switch.

13. In combination, a railway switch, a relay, a motor controlled by said relay for operating said switch, and means located adjacent the trackway and responsive to sound waves of a particular frequency transmitted from a train approaching said switch for at times operating said relay.

14. In combination, a railway switch, a track circuit adjacent said switch, a relay, a motor controlled by said relay and by said track circuit for operating said switch, and means located adjacent the trackway and responsive to sound waves from a train whistle for at times operating said relay.

15. In combination, a railway switch, a first relay, means located adjacent the trackway and responsive to sound waves from a train whistle for at times operating said first relay, a second relay controlled by said first relay, and a motor controlled by said second relay for operating said switch.

16. In combination, a railway switch, a track circuit adjacent said switch, a sound responsive device, and means controlled by said device and by said track circuit and responsive to a predetermined code of sound impulses to operate said switch.

17. In combination, a railway switch, a track circuit adjacent said switch and means controlled by said track circuit and responsive only to the sound waves from a train whistle for operating said switch.

18. In combination, a first, and a second section of railway track, a railway switch located in advance of said two sections, a track relay for each said section, a microphone located adjacent the trackway, a source of unidirectional current, a transformer; a circuit for the primary of said transformer including said microphone, said source, a front contact of the track relay for the second section and a back contact of the track relay for the first section; a filter, an auxiliary relay connected with the secondary of said transformer through said filter, a stick circuit for said auxiliary relay including a back contact of the track relay for said first section, a polarized relay, means controlled by said auxiliary relay and by the track relay for the second section for supplying said polarized relay with current of one polarity or the

other, and means controlled by said polarized relay for actuating said switch.

19. In combination, a railway switch, a track circuit adjacent said switch, a sound responsive device located adjacent the trackway, and means controlled by said device and by said track circuit for operating said switch.

20. In combination, a stretch of railway track provided with a switch, a track circuit adjacent said switch, a microphone located adjacent the trackway, a relay controlled by said microphone, and means controlled by said relay and by said track circuit for at times operating said switch.

21. In combination, a railway switch, a track circuit adjacent said switch, a sound responsive device, and means controlled by said device and by said track circuit for operating said switch.

In testimony whereof I affix my signature.

SAMUEL M. LUCAS.