

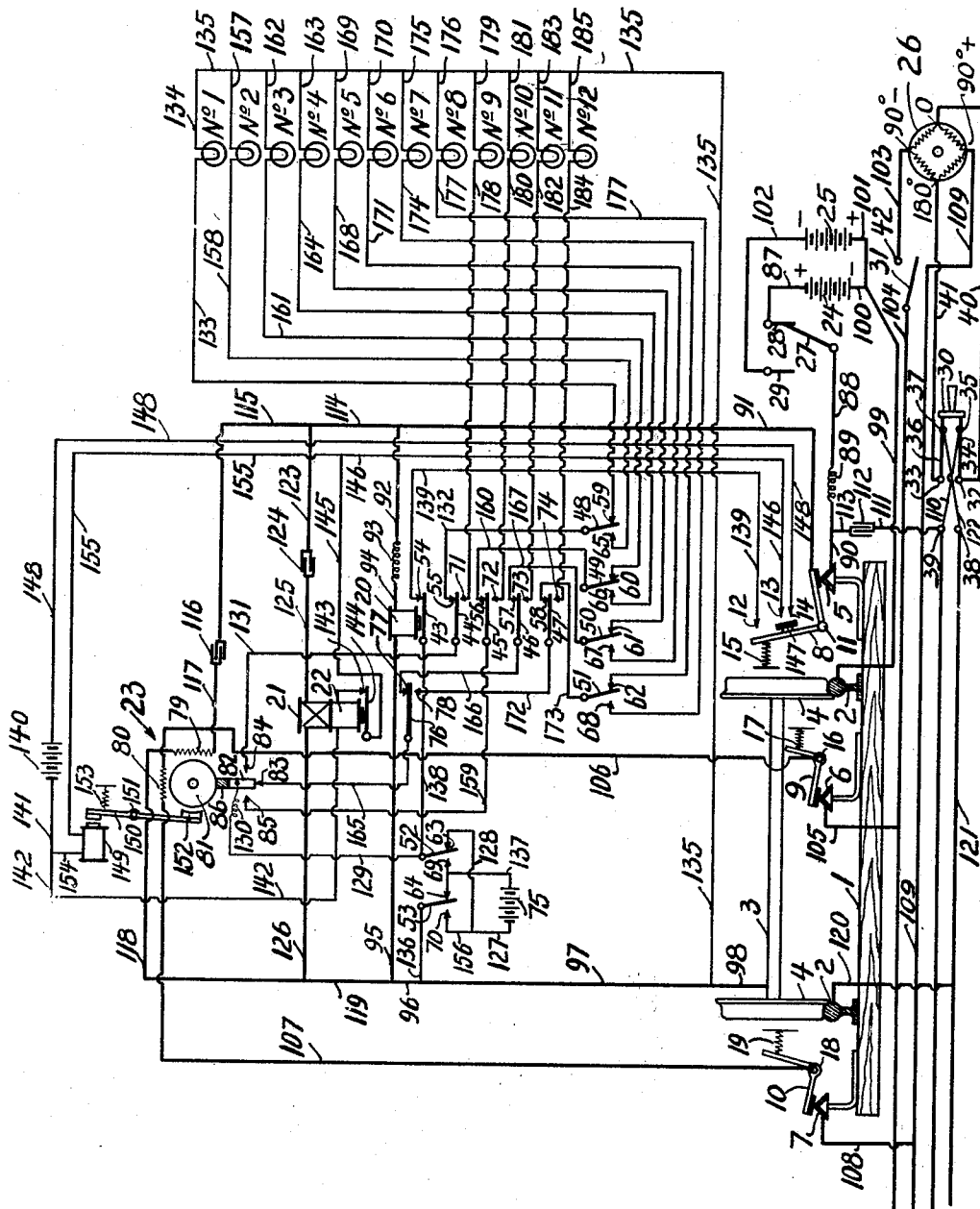
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AUTOMATIC TRAIN CONTROL

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AUTOMATIC TRAIN CONTROL

Substitute for application Serial No. 652,691, filed July 20, 1923, and abandoned. This application filed September 5, 1928. Serial No. 304,134.

This invention relates to railways and particularly to the control of cars or trains thereon.

An important object of this invention is an arrangement and construction of train control whereby trackway means are enabled to create a plurality of distinctive conditions upon the car or train, which distinctive conditions may be used to appropriately govern the train in as many different ways.

In describing the principle of the invention reference is had to an illustrative physical embodiment illustrated by a single schematic view in the drawing forming a part of this specification, which drawing illustrates the invention as applied to a car.

In the drawing, an ordinary railroad tie is shown at 1. Mounted on this tie in the usual and ordinary manner are the rails 2. A car is illustrated as being on the rails 2 by the showing of the ordinary axle 3 and the wheels 4. Suitably supported on the ties 1 are train control rails 5, 6 and 7, which are electrically insulated from the track rails and consist of short sections of metal approximately 60 feet long and spaced at suitable locations along the track. The train control rails are inclined at the ends so as to form ramps in the usual manner such as is shown in my prior Patent No. 1,140,623 granted May 25, 1915. Suitably supported on the frame of the locomotive or car, but electrically insulated therefrom, are three contact shoes 8, 9 and 10, so positioned as to make contact with train control rails 5, 6 and 7 respectively. Contact shoe 8 is hinged at 11 and when the contact shoe slides along the train control rail, the shoe is tilted so as to break contacts 12, 13 and 14. When the shoe leaves the train control rail, a spring 15 forces the contact shoe to the normal position thus again closing contacts 12, 13 and 14. Contact shoe 9 is hinged at 16 and when not in contact with a train control rail, it is held by a suitable stop, not shown, in a horizontal position but when entering upon a train control rail, it is tilted thus compressing a spring 17, and when this shoe leaves the train control rail, spring 17 forces the shoe back to the normal or horizontal position. Contact shoe 10 is hinged

at 18 and when not in contact with a train control rail, it is held by a suitable stop, not shown, in a horizontal position, but when entering upon a train control rail, is tilted, thus compressing a spring 19, and when this shoe leaves the train control rail, spring 19 forces the shoe back to the normal position.

The locomotive or car also carries a polarized relay 20, an alternating current relay 21 with its companion holding coil 22, and a three position alternating current motor relay 23. These relays control their several armatures depending upon the character of the energization or the deenergization of the relay coils, and the armatures in turn control the circuits through the several signals designated as Nos. 1 to 12 inclusive. While these devices are designated signals and are shown as lamps, they may be electro-magnetic devices to which motion is given, depending upon whether the circuit is energized or deenergized, and such electro-magnetic devices may be used for other purposes than, or in addition to, the display of signals to the engineer.

Train control rails 5, 6 and 7, may be placed transversely in any position in relation to the track rails, usually determined by the clearance lines of the equipment operating over the railway, but longitudinally they are of the same length and opposite to each other.

Along the track are located the direct current sources such as batteries 24 and 25 and an alternating current source 26. A switch as 27 controls the energization or deenergization from batteries 24 or 25 of the train control rail 5. When switch 27 is in contact with spring contact 28, train control rail 5 is positively energized. When switch 27 is in contact with spring contact 29, train control rail 5 is negatively energized. When switch 27 is open, train control rail 5 is deenergized, insofar as direct current is concerned. The current from alternating current source 26 for energizing train control rail 5 in different ways is controlled by a switch 30, and the energization or deenergization of train control rails 6 or 7 from alternating current source 26 is controlled by a

switch 31. The alternating current source 26 has four terminals representing the zero, 90° plus, 90° minus and 180° phase positions. Switch 30 is a two pole, double throw switch hinged at 32 and 33, and when in the right hand position as shown in the figure, pole member 34 makes contact with terminal as 35, and pole member 36 makes contact with terminal as 37. When switch 30 is in the left hand position, opposite to that shown in the figure, pole member 34 makes contact with terminal 38 and pole member 36 makes contact with terminal 39. The two poles of switch 30 are connected by wires 40 and 41 to the zero and 180° terminals of alternating current source 26. Switch 31, when in contact with terminal 42, connects train control rails 6 and 7 to the 90° minus and the 90° plus terminals of alternating current source 26. When switch 31 is open train control rails 6 and 7 are deenergized. When switch 30 is in the right hand position as shown in the figure, thus making contact with terminals 35 and 37, and switch 31 is closed, train control rail 5 is energized with alternating current of a phase leading with respect to the phase present in the train control rails 6 and 7, and when switch 30 is in the left hand position, opposite to that shown in the figure, thus making contact with terminals 38 and 39, and switch 31 is closed, train control rail 5 is energized with alternating current of a phase lagging with respect to the phase present in the train control rails 6 and 7. When switch 30 is open train control rail 5 is deenergized insofar as alternating current is concerned.

Depending upon the character of the energization of train control rails 5, 6 and 7, or deenergization, the armatures of relays 20, 21 and 23 assume certain positions, thus closing a circuit through one of the twelve signal lamps.

The circuit through signal No. 1 is closed when train control rail 5 is energized with positive direct current and also energized with leading alternating current with respect to alternating current in train control rail 7 and train control rails 6 and 7 are also energized.

The circuit through signal No. 2 is closed when train control rail 5 is energized with negative direct current and also energized with leading alternating current with respect to alternating current in train control rail 7 and train control rails 6 and 7 are also energized.

The circuit through signal No. 3 is closed when train control rail 5 is energized with positive direct current and also energized with lagging alternating current with respect to alternating current in train control rail 7 and train control rails 6 and 7 are also energized.

The circuit through signal No. 4 is closed

when train control rail 5 is energized with negative direct current and also energized with lagging alternating current with respect to alternating current in train control rail 7 and train control rails 6 and 7 are also energized.

The circuit through signal No. 5 is closed when train control rail 5 is energized with positive direct current and alternating current and train control rails 6 and 7 are deenergized.

The circuit through signal No. 6 is closed when train control rail 5 is energized with negative direct current and alternating current and train control rails 6 and 7 are deenergized.

The circuit through signal No. 7 is closed when train control rail 5 is energized with positive direct current and train control rails 5, 6 and 7 are deenergized with respect to alternating current.

The circuit through signal No. 8 is closed when train control rail 5 is energized with negative direct current and train control rails 5, 6 and 7 are deenergized with respect to alternating current.

The circuit through signal No. 9 is closed when train control rail 5 is deenergized in respect to direct current and energized with leading current with respect to alternating current in train control rail 7 and train control rails 6 and 7 are also energized.

The circuit through signal No. 10 is closed when train control rail 5 is deenergized with respect to direct current and energized with lagging current with respect to alternating current in train control rail 7 and train control rails 6 and 7 are also energized.

The circuit through signal No. 11 is closed when train control rail 5 is deenergized with respect to direct current and energized with alternating current and train control rails 6 and 7 are deenergized.

The circuit through signal No. 12 is closed when train control rails 5, 6 and 7 are deenergized with respect to both direct current and alternating current.

Switches 27, 30 and 31 may be manually operable switches suitably housed in a way station, interlocking tower or dispatcher's office or they may equally as well represent armatures of track relays by which the twelve different electrical conditions of train control rails 5, 6 and 7 may be established automatically in a manner similar to that shown in my prior Patent No. 1,315,346 granted September 9, 1919, or some of the twelve conditions may be controlled automatically by a track circuit and others by manually operable switches.

Polarized relay 20 controls armatures 43, 44, 45, 46 and 47 and polarized armatures 48, 49, 50, 51, 52 and 53. When this relay is positively energized, its neutral armatures make contact with contacts 54, 55, 56, 57

and 58 respectively and the polarized armatures will be in the right hand position as shown in the figure and make contact with contacts 59, 60, 61, 62, 63 and 64. When polarized relay 20 is negatively energized its neutral armatures will also make contact with their respective front contacts, but the polarized armatures will assume the left hand position, opposite to that shown in the figure, and make contact with contacts 65, 66, 67, 68, 69 and 70. When polarized relay 20 is deenergized, its neutral armatures will drop away from the front contacts and its armatures 44, 45, 46 and 47 will make contact with back contacts 71, 72, 73 and 74. Polarized armatures 52 and 53 are members of a pole changing switch for the purpose of changing the direction of the flow of current from battery 75.

The alternating current relay 21 controls armatures 76 and 144 and when the relay is energized the armatures will close front contacts 77 and 143 and when deenergized armature 76 will close back contact 78. The holding coil 22 of relay 21 is controlled by a direct current stick circuit for the purpose of continuing the indication after the train has passed the train control rails as will be more fully described hereinafter.

The three position, motor type, alternating current relay 23 has two windings 79 and 80. Its rotor 81 controls a contact arm 82. The rotor 81 is so balanced that when one of the windings of this relay is deenergized, the rotor will assume the neutral position as shown in the figure, and in this position contact arm 82 makes contact with contact 83. When windings 79 and 80 of motor relay 23 are energized, and winding 79 is energized with leading current with respect to winding 80, the rotor 81 will rotate counter-clockwise and contact arm 82 will make contact with contact 84, and when windings 79 and 80 are energized and the current in winding 79 is lagging with respect to current in winding 80, the rotor 81 will rotate clockwise, and contact arm 82 will make contact with contact 85. Contact arm 82 is insulated from rotor 81 by insulation 86.

When contact shoe 8 is in contact with train control rail 5, and switch 27 in contact with contact 28, polarized relay 20 is positively energized through the following circuit: From positive pole of battery 24, wire 87, spring contact 28, switch 27, wire 88, impedance 89, wire 90, train control rail 5, contact shoe 8, wires 91 and 92, impedance 93, wire 94, polarized relay 20, wires 95, 96, 97 and 98, axle 3, wheel 4, track rails 2, wires 99 and 100, to the negative pole of battery 24. When contact shoe 8 is in contact with train control rail 5 and switch 27 is in contact with contact 29, polarized relay 20 is negatively energized through the following circuit: From positive pole of battery 25, wires 101 and 99,

track rail 2, wheel 4, axle 3, wires 98, 97, 96 and 95, polarized relay 20, wire 94, impedance 93, wires 92 and 91, contact shoe 8, train control rail 5, wire 90, impedance 89, wire 88, switch 27, spring contact 29, and wire 102 to negative pole of battery 25. Polarized relay 20 is deenergized when switch 27 is disconnected from both spring contacts 28 and 29.

When contact shoes 9 and 10 are in contact with train control rails 6 and 7, and switch 31 is closed, winding 80 of relay 23 is energized through the following circuit: From minus 90° terminal of alternating current source 26, wire 103, terminal 42, switch 31, wires 104, and 105, train control rail 6, contact shoe 9, wire 106, winding 80, wire 107, contact shoe 10, train control rail 7, wires 108 and 109, to plus 90° terminal of alternating current source 26. Winding 80 of relay 23 is deenergized when switch 31 is open. When contact shoe 8 is in contact with train control rail 5, and switch 30 is in the position shown, winding 79 is energized with leading alternating current with respect to winding 80, through the following circuit: From zero terminal of alternating current source 26, wire 40, hinge 32, pole member 34, terminal 35, wire 110, terminal 39, wire 111, condenser 112, wires 113 and 90, train control rail 5, contact shoe 8, wires 91, 114, and 115, condenser 116, wire 117, winding 79, wires 118, 119, 96, 97 and 98, axle 3, wheel 4, track rail 2, wires 120 and 121, terminal 38, wire 122, terminal 37, pole member 36, hinge 33, wire 41 to the 180° terminal of alternating current source 26. When contact shoe 8 is passing train control rail 5, and switch 30 is in the position opposite to that shown, winding 79 is energized with lagging alternating current with respect to winding 80 through the following circuit: From 180° terminal of alternating current source 26, wire 41, hinge 33, pole member 36, terminal 39, wire 111, condenser 112, wires 113 and 90, train control rail 5, contact shoe 8, wires 91, 114 and 115, condenser 116, wire 117, winding 79, wires 118, 119, 96, 97 and 98, axle 3, wheel 4, track rail 2, wires 120 and 121, terminal 38, pole member 34, hinge 32, wire 40 to zero terminal of alternating current source 26. When switch 30 is open, winding 79 is deenergized.

When contact shoe 8 is in contact with train control rail 5, and switch 30 is either in the left hand or the right hand position, relay 21 will be energized through the following circuit: From zero terminal of alternating current source 26, wire 40, hinge 32, pole member 34, terminal 35, wire 110, terminal 39, wire 111, condenser 112, wires 113 and 90, train control rail 5, contact shoe 8, wires 91, 114, and 123, condenser 124, wire 125, relay 21, wires 126, 119, 96, 97 and 98, axle 3, wheel 4, track rail 2, wires 120 and 121, terminal 38, wire 122, terminal 37, pole member 36, hinge 33, and wire 41 to the 180° terminal of the

alternating current source 26. The foregoing circuit is closed when switch 30 is in the right hand position in contact with terminals 35 and 37. When switch 30 is in the left hand position, in contact with terminals 38 and 39 a similar circuit is closed. When switch 30 is open, relay 21 is deenergized.

Impedances 89 and 93 are inserted in the circuit to prevent the flow of alternating current therethrough and condensers 112, 116 and 124 are inserted to prevent the flow of direct current through their respective circuits.

I will now describe the circuits through which the signals from No. 1 to No. 12 are energized.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is in contact with spring contact 28 and switch 31 is closed and switch 30 is in contact with terminals 35 and 37, then polarized relay 20 is positively energized, relay 21 is energized and winding 79 of relay 23 is energized with leading current with respect to winding 80, thus placing contact arm 82 in contact with contact 84. Under these conditions a circuit is closed through signal No. 1 as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 129, flexible connection 130, contact arm 82, contact 84, wire 131, armature 44 of relay 20, front contact 55, wire 132, polarized armature 48, contact 59, wire 133, signal No. 1, wires 134, 135, 97 and 136, polarized armature 53, contact 64, wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, a stick circuit is closed through polarized relay 20, which continues to energize this relay positively as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 138, armature 43 of polarized relay 20, front contact 54, wire 139, contact 12, contact shoe 8, wires 91 and 92, impedance 93, wire 94, polarized relay 20, wires 95, 96 and 136, polarized armature 53, contact 64, wire 137 to negative pole of battery 75. This stick circuit will be referred to hereinafter as the positive direct current stick circuit.

Alternating current relay 21 is also maintained energized after the contact shoes have left the train control rails through the following stick circuit: From positive pole of battery 140, wires 141 and 142, direct current coil 22 of relay 21, front contact 143, armature 144, wires 145 and 146, contact 13, metallic plate 147, contact 14, and wire 148 to the negative pole of battery 140. Metallic contact plate 147 is attached to shoe 8 but insulated therefrom. It will thus be seen that when shoe 8 is in contact with train control rail 5, contacts 13 and 14 are open, thus deenergizing coil 22 of relay 21 and unless alternating current relay 21 is supplied with alternating current, from alternating current

source 26, this relay will become deenergized. If energized however from alternating current source 26, relay 21 will continue to be energized through coil 22 just before and after contact shoe 8 has left the train control rail and contacts 13 and 14 are again closed. This stick circuit through relay 21 will be referred to hereinafter as the relay 21 stick circuit.

Contact arm 82 attached to rotor 81 is also maintained in contact with contact 84 after contact shoe 8 has left the train control rail through the following arrangement: Locking magnet 149 controls an armature 150, pivoted at 151. To an extension of armature 150 is attached a friction shoe 152. When locking magnet 149 is energized armature 150 will press friction shoe 152 against rotor 81 or the shaft thereof, thus holding the rotor in the position it is in. When locking magnet is deenergized a spring 153 pulls armature 150 away from rotor 81, thus releasing the friction through friction shoe 152 upon rotor 81. When the contact shoe is not in contact with train control rail 5, contacts 13 and 14 are closed and thus a circuit is established through locking magnet 149 as follows: From battery 140, wires 141 and 154, locking magnet 149, wires 155 and 146, contact 13, metallic plate 147, contact 14, and wire 148 to opposite side of battery 140. It will thus be seen that when contact shoe 8 is in contact with train control rail 5, contacts 13 and 14 are broken thus deenergizing locking magnet 149 and rotor 81 is free to assume either of its three positions. As soon however as contact shoe 8 reaches the sloping end of rail 5 and also after it leaves the rail, contacts 13 and 14 are again made and locking magnet 149 is again energized, thus holding rotor 81 in the position it is placed when passing the train control rail. This circuit which controls locking magnet 149 will be referred to hereinafter as the relay 23 holding circuit.

With the train control rails energized so as to display signal No. 1 as hereinbefore described and the positive direct current stick circuit, the relay 21 stick circuit, and the relay 23 holding circuit all in effect as contact shoe 8 leaves the train control rail, signal No. 1 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is in contact with spring contact 29 and switch 31 is closed, and switch 30 is in contact with terminals 35 and 37, then polarized relay 20 is negatively energized, relay 21 is also energized and winding 79 of relay 23 is energized with leading current with respect to winding 80, thus placing contact arm 82 in contact with contact 84. Under these conditions a circuit is closed through signal No. 2 as follows: From positive pole of battery 75, wires 127 and 156, contact 70, po-

larized armature 53, wires 136, 97, 135 and 157, signal No. 2, wire 158, contact 65, armature 48, wire 132, front contact 55, armature 44, wire 131, contact 84, contact arm 82, flexible connection 130, wire 129, armature 52, contact 69, and wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, relay 21 stick circuit and relay 23 holding circuit are again in effect and a stick circuit is also established through relay 20 as follows: From positive pole of battery 75, wires 127 and 156, contact 70, polarized armature 53, wires 136, 96 and 95, polarized relay 20, wire 94, impedance 93, wires 92 and 91, contact shoe 8, contact 12, wire 139, front contact 54, armature 43, wire 138, polarized armature 52, contact 69 and wire 137 to negative pole of battery 75. This stick circuit will be referred to hereinafter as the negative direct current stick circuit. With the negative direct current stick circuit, relay 21 stick circuit and relay 23 holding circuit all three in effect, signal No. 2 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is in contact with spring contact 28, and switch 31 is closed and switch 30 is in contact with terminals 38 and 39, then polarized relay 20 is positively energized, relay 21 is also energized and winding 79 of relay 23 is energized with lagging current with respect to winding 80, thus placing contact arm 82 in contact with contact 85. Under these conditions a circuit is closed through signal No. 3 as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 129, flexible connection 130, contact arm 82, contact 85, wire 159, armature 45 of relay 20, front contact 56, wire 160, polarized armature 49, contact 60, wire 191, signal No. 3, wires 162, 135, 97 and 136, polarized armature 53, contact 64, and wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, the positive direct current stick circuit, the relay 21 stick circuit, and the relay 23 holding circuit are all three in effect and signal No. 3 is continued, until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is in contact with spring contact 29, and switch 31 is open and switch 30 is in contact with terminals 35 and 37 or 38 and 39, then polarized relay 20 is negatively energized, relay 21 is also energized and relay 23 is deenergized. Under these conditions a circuit is closed through signal No. 6 as follows: From positive pole of battery 75, wires 127 and 156, contact 70, polarized armature 53, wires 136, 97, 135 and 170, signal No. 6, wire 171, contact 67, polarized armature 50, wire 167, front contact 57, armature 46, wire 166, front contact 77, armature 76, wire 165, contact 83, contact arm 82, flexible connection 130, wire 129, polarized armature 52, contact 69, wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, the negative direct current stick circuit, the relay 21 stick circuit and the relay 23 holding circuit are all three in effect and signal No. 6 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is in contact with spring contact 29, and switch 31 is closed, and switch 30 is in contact with terminals 38 and 39, then polarized relay 20 is negatively energized, relay 21 is also energized and winding 79 of relay 23 is energized with lagging current with respect to winding 80, thus placing contact arm 82 in contact with contact 85. Under these conditions a circuit is closed through signal No. 4 as follows: From positive pole of battery 75, wires 127 and 156, contact 70, polarized armature 53, wires 136, 97, 135 and 163, signal No. 4, wire 164, contact 66, polarized armature 49, wire 160, front contact 56, armature 45, wire 159, contact 85, contact arm 82, flexible connection 130, wire 129, polarized armature 52, contact 69, and wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, the negative direct current stick circuit, the relay 21 stick circuit, and the relay 23 holding circuit are all three in effect and signal No. 4 is continued until the next train control rail is reached.

When contact shoes 8, 9, and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is in contact with spring contact

28, and switch 31 is either open or closed and switch 30 is open, then polarized relay 20 is positively energized, relay 21 is deenergized and relay 23 is also deenergized. Under these conditions a circuit is closed through signal No. 7 as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 129, flexible connection 130, contact arm 82, contact 83, wire 165, armature 76, back contact 78, wire 172, armature 47, front contact 58, wire 173, polarized armature 51, contact 62, wire 174, signal No. 7, wires 175, 135, 97 and 136, polarized armature 53, contact 64, and wire 137 to the negative pole of battery 75. When the contact shoe leaves the train control rail, the positive direct current stick circuit and the relay 23 holding circuit are both in effect but the relay 21 stick circuit is now open at front contact 143 thus keeping relay 23 deenergized, and signal No. 7 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is in contact with spring contact 29 and switch 31 is either open or closed and switch 30 is open, then polarized relay 20 is negatively energized and relays 21 and 23 are both deenergized. Under these conditions a circuit is closed through signal No. 8 as follows: From positive pole of battery 75, wires 127 and 156, contact 70, polarized armature 53, wires 136, 97, 135 and 176, signal No. 8, wire 177, contact 68, polarized armature 51, wire 173, front contact 58, armature 47, wire 172, back contact 78, armature 76, wire 165, contact 83, contact arm 82, flexible connection 130, wire 129, polarized armature 52, contact 69, and wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, the negative direct current stick circuit and the relay 23 holding circuit are in effect but relay 21 stick circuit is now open at front contact 143 and signal No. 8 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7 and switch 27 is open and switch 31 is closed and switch 30 is in contact with terminals 35 and 37, then polarized relay 20 is deenergized, relay 21 is energized and winding 79 of relay 23 is energized with leading current with respect to winding 80, thus placing contact arm 82 in contact with contact 84. Under these conditions a circuit is closed through signal No. 9 as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 129, flexible connection 130, contact arm 82, contact 84, wire 131, armature 44, back contact 71, wire 178, signal No. 9, wires 179, 135, 97 and 136, polarized armature 53, contact 64, wire 137, to the negative pole of battery 75. When the contact shoe leaves the train control rail, the relay 21 stick

circuit and the relay 23 holding circuit are both in effect but the direct current stick circuit through relay 20 is now open at front contact 54, and signal No. 9 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7, switch 27 is open and switch 31 is closed and switch 30 is in contact with terminals 38 and 39, then polarized relay 20 is deenergized relay 21 is energized and winding 79 of relay 23 is energized with lagging current with respect to winding 80, thus placing contact arm 82 in contact with contact 85. Under these conditions a circuit is closed through signal No. 10 as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 129, flexible connection 130, contact arm 82, contact 85, wire 159, armature 45, back contact 72, wire 180, signal No. 10, wires 181, 135 and 136 polarized armature 53, contact 64, and wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail the relay 21 stick circuit and the relay 23 holding circuit are both in effect but the direct current stick circuit through relay 20 is now open at front contact 54 and signal No. 10 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7, switch 27 is open, and switch 31 is open and switch 30 is in contact with terminals 35 and 37 or 38 and 39, then polarized relay 20 is deenergized, relay 21 is energized and relay 23 is also deenergized, thus placing contact arm 82 in contact with contact 83. Under these conditions a circuit is closed through signal No. 11 as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 129, flexible connection 130, contact arm 82, contact 83, wire 165, armature 76, front contact 77, wire 166, armature 46, back contact 73, wire 182, signal No. 11, wires 183, 135, 97 and 136, polarized armature 53, contact 64, and wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, the relay 21 stick circuit and the relay 23 holding circuit are both in effect but direct current stick circuit through relay 20 is now open at front contact 54 and signal No. 11 is continued until the next train control rail is reached.

When contact shoes 8, 9 and 10 are in contact with train control rails 5, 6 and 7, and switch 27 is open and switch 31 is open or closed and switch 30 is open, then all three relays 20, 21 and 23 are deenergized and a circuit is closed through signal No. 12 as follows: From positive pole of battery 75, wires 127 and 128, contact 63, polarized armature 52, wire 129, flexible connection 130, contact arm 82, contact 83, wire 165, armature 76, back contact 78, wire 172, armature 47, back contact 74, wire 184, signal No. 12, wires 185,

135, 97 and 136, polarized armature 53, contact 64, and wire 137 to negative pole of battery 75. When the contact shoe leaves the train control rail, the relay 23 holding circuit is in effect but the direct current stick circuit through relay 20 is now open at front contact 54 and the relay 21 stick circuit is open at front contact 143 and signal No. 12 is continued until an energized train control rail is reached.

The utility of the invention consists in providing a multiplicity of signal indications. These signals may be automatically controlled by track circuits in which case they would indicate the gradual approach of a train on which the signals are located toward another train or other danger, or the signals may be used to convey useful information to the engineer. The tendency in modern methods of train operation is to eliminate as far as possible, telegraphic and telephonic train orders to the train crew, such methods are the cause of frequent errors and expensive delay of trains. The invention described herein provides for as many as twelve signal indications, all based on normally closed circuit principles, thus giving opportunity for many positive and distinct instructions to the engineer, each signal designating a certain instruction or order as the railway management may designate.

It is obvious that the twelve conditions or signal indications may not necessarily be given on a car or train, but may be expressed through fixed signals or other apparatus along the right of way. To arrange the circuits for use the control of fixed signals it is only necessary to eliminate the use of train control rails and contact shoes and permanently connect the wires which are shown on the drawing as connected to the respective train control rails and contact shoes.

Although I have particularly described one of the physical embodiments of my invention and illustrated the same, nevertheless I desire to have it understood that the particular form illustrated is merely illustrative and does not exhaust the possible embodiment of means underlying the principle of my invention.

What is claimed is:

1. In an automatic train control, in combination, a source of direct current, a second source of direct current, a source of alternating current of a plurality of phases, three ramps, connections between one of the ramps and the sources of direct current and between all of the ramps and the source of alternating current, switching means interposed in these connections, a vehicle, train control means on the vehicle, and means on the vehicle connecting at times with the ramps and connected to the vehicle control means whereby more than nine conditions are created in the vehicle control means.

2. In an automatic train control, in com-

bination a vehicle, an alternating current relay on the vehicle having an armature, a polarized relay on the vehicle having an armature, and means including sources of direct current and a source of alternating current whereby the relay armatures are variously positioned, and means for utilizing the various positions to establish more than nine different electrical circuits.

3. In an automatic train control in combination, a source of direct current, a second source of direct current, a source of alternating current of a plurality of phases, three ramps, connections between one of the ramps and the sources of direct current and between all of the ramps and the source of alternating current, switching means interposed in these connections, a vehicle, train control means on the vehicle including three different relays, and means on the vehicle connecting at times with the ramps and connected to the vehicle control means whereby more than nine conditions are created in the vehicle control means.

4. In an automatic train control, in combination a vehicle, a rotary alternating current relay on the vehicle having an armature, a polarized relay on the vehicle having an armature, a second alternating current relay on the vehicle having an armature, and means including sources of direct current and a source of alternating current whereby the relay armatures are variously positioned, and means for utilizing the various positions, in more than nine different ways.

5. A train control system comprising a vehicle, at least three relays on the vehicle, each of said relays being capable of assuming a plurality of positions corresponding to the electrical condition thereof, some of said relays being responsive to a plurality of currents of different kinds, means along the trackway for simultaneously supplying currents of different kinds to some of said relays whereby predetermined positions are established, a source of current on the vehicle, a plurality of independent signal circuits on the vehicle, and signals in said circuits, said signal circuits and source of current being correlated with said relays to display a predetermined signal in accordance with the electrical conditions thereof.

6. A train control system comprising a vehicle, at least three relays on the vehicle, each of said relays being capable of assuming a plurality of positions corresponding to the electrical condition thereof, some of said relays being responsive to a plurality of currents of different kinds, means along the trackway for simultaneously supplying currents of different kinds to some of said relays whereby predetermined positions are established, a source of current on the vehicle, a plurality of independent signal circuits on the vehicle,

signals in said circuits, said signal circuits
and source of current being correlated with
said relays to display a predetermined signal
in accordance with the electrical conditions
thereof, and means to maintain said signal
5 circuits until the relay positions are changed.

PAUL J. SIMMEN.

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