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W. MACOMBER.

RAILWAY SWITCHING AND SIGNALING APPARATUS.

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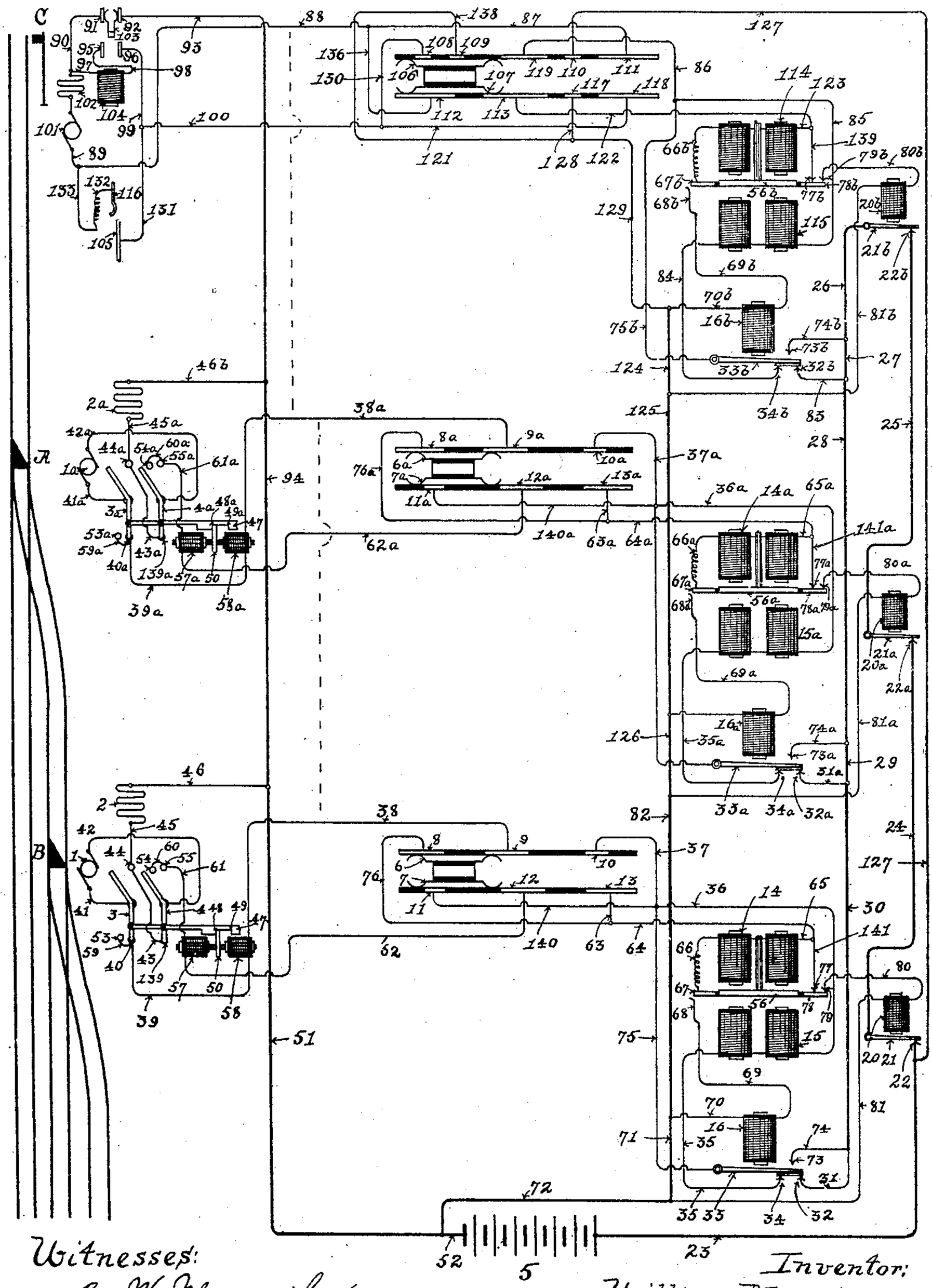

UNITED STATES PATENT OFFICE.

WILLIAM MACOMBER, OF BUFFALO, NEW YORK, ASSIGNOR TO GENERAL RAILWAY SIGNAL COMPANY, OF BUFFALO, NEW YORK, A CORPORATION OF NEW YORK.

RAILWAY SWITCHING AND SIGNALING APPARATUS.

No. 832,137. Specification of Letters Patent. Patented Oct. 2, 1906.

Application filed February 20, 1905. Serial No. 246,534.

To all whom it may concern:

Be it known that I, WILLIAM MACOMBER, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Railway Switching and Signaling Apparatus, of which the following is a specification.

My invention relates to certain new and useful improvements in railway switching and signaling apparatus.

It relates more particularly to improvements in railway switching and signaling apparatus in which the energy employed to move the switch or signal and to give indication of such movement is electric energy.

My present invention is furthermore directly related to and an improvement upon my pending application, Serial No. 198,220, filed March 15, 1904.

The objects of my invention are, first, to provide means whereby two or more units of a system may be coincidently operated without in any manner interfering with each other; second, to provide means whereby in the event of a cross of any wire leading from one pole of the common battery with a wire leading to the opposite pole of such battery will prevent any movement of any unit of the system involved until such cross is removed; third, to provide means whereby in the event of such a cross any signal set at the reverse position will remain at such reverse position notwithstanding such cross and the cutting off of the battery from all other units.

In the description of my invention I shall refer to my said application, Serial No. 198,220, filed March 15, 1904, since the mechanism therein employed is absolutely identical with the mechanism herein shown, with the single exception of an additional contact-point upon the controller of the signal.

1 2 represent the motor for moving the switch B. 1^a 2^a represent the motor for moving the switch A, and 101 102 represent the motor for moving the signal C. 3 4 and 3^a 4^a are the arms of the pole-changing switches for reversing the current through the switch-motors. 103 104 are respectively a snap-switch and a brake-magnet for controlling the signal-motor. 5 is a source of electric energy. 6 7 and 6^a 7^a are the brushes, and 8 9 10 11 12 13 and 8^a 9^a 10^a 11^a 12^a 13^a are the contacts of the controllers governing the switches. 106 107 are the brushes, and 108 109 119 110 111 112 113 117 118 are the contacts of the controller governing the signal. 15 and 15^a are the safety-magnets of the switches, and 115 represents the safety-magnets of the signal. 14 and 14^a are the indicating-magnets of the switches, and 114 represents the indicating-magnets of the signal. 16 16^a 16^b are the cut-out magnets. The magnets 57 58 and the armature 50 and the bar 47 with the notches 48 and 49 and the magnets 57^a 58^a, the amature 50^a and the bar 47^a, and the notches 48^a and 49^a constitute the mechanism for governing the pole-changing switch. The contact-piece 116 and the contact-plate 105 constitute the electrical contact through which indication of the return of the signal to normal is obtained. The parts thus indicated will be found substantially identical with and indicated by corresponding reference characters with the corresponding parts in my said pending application, Serial No. 198,220. They therefore need not be described in detail in this application, since they are fully shown and described in said pending application.

20 20^a 20^b are cut-out magnets which govern the tongues 21 21^a 21^b, which are normally in contact with the contact-points 22, 22^a, and 22^b. The manner in which these magnets 20, 20^a, and 20^b are actuated will be hereinafter described.

I will first describe a normal movement of the switch B. Suppose it is desired to reverse said switch B. The controller is moved so that the brushes 6 and 7 bridge the contacts 9 10 and 12 13, respectively. This closes a circuit of the battery 5, including the motor 1 2, so that current flows through wire 23, contact 22, tongue 21, wire 24, contact 22^a, tongue 21^a, wire 25, contact 22^b, tongue 21^b, wires 26 27 28 29 30 31, contact 32, tongue 33, contact 34, wire 35, safety-magnets 15, wires 36 37, contact 10, brush 6, contact 9, wire 38, magnet 58, wire 39, contact 40, switch-arm 3, wire 41, motor-armature 1, wire 42, switch-arm 4, contact 139, wire 43, contact 44, wire 45, field-coils 2, and wires 46, 51, and 52, back to battery 5. This current energizes the switch-motor and at the same time energizes the safety-magnets 15 and the magnet 58. The energizing of the

magnet 58 moves the armature 50 toward the shoulder 49, so that when the arms of the pole-changing switch are released, when the switch has completed its full movement and is home and locked, they will make contact with the contacts 53 and 54, respectively, and will be held in such contact position until such time as the magnet 58 is deënergized, when they will complete their movement and make contact with the contact-pieces 44 and 55. The energizing of the safety-magnets 15 will have caused the armature 56 to move downward and release the controller-bar, as fully described in my said aforementioned pending application, and will also move the contact-piece 78 out of electrical connection with the contacts 77 and 79, and the contact-piece 67 will make electrical connection with the contact 68. As soon as the movement of the switch is completed and the arms 3 4 of the pole-changing switch have made the initial movement and gone to contact with the contact-pieces 53 and 54 and broken contact with the contact-pieces 40 and 139 a circuit will then be established, so that current will flow from the battery 5 through wire 23, contact 22, tongue 21, wire 24, contact 22^a, tongue 21^a, wire 25, contact 22^b, tongue 21^b, wires 26 27 28 29 30 31, contact 32, tongue 33, contact 34, wire 35, safety-magnets 15, wires 36 37, contact 10, brush 6, contact 9, wire 38, magnet 58, wire 39, contact 40, wire 59, contact 53, switch-arm 3, wire 41, armature 1, wire 42, switch-arm 4, contact 54, wire 60, contact 55, wire 61, magnet 57, wire 62, contact 12, brush 7, contact 13, wires 63 64 65, indicating-magnets 14, the flexible connection 66, contact-piece 67 rigidly secured to but insulated from the armature 56, contact 68, wire 69, cut-out magnet 16, wires 70, 71, 72, and 52, back to battery. This current maintains the energy of the safety-magnets and also magnet 58. It also energizes the indicating-magnets 14, the cut-out magnet 16, and the magnet 57. Since the armature 50 is already drawn into contact with the magnet 58, the energy of the magnet 57, which is substantially equally wound with the magnet 58, will not draw the armature 50 away from said magnet 58; but the energizing of the cut-out magnet 16 will cause the tongue 33 to rise and make contact with the contact-piece 73 and break contact with the contacts 32 and 34, so that current flowing from the wire 30, instead of passing through the wire 31, contact 32, tongue 33, contact 34, wire 35, safety-magnets 15, and wire 36, as above described, will pass from said wire 30 through wire 74, contact 73, tongue 33, and wire 75 to wire 37, and thence through the path just described, thus cutting out the safety-magnets 15 and deënergizing them. Since the indicating-magnets 14 are still included in the circuit and the armature 56 is released by the deënergizing of the magnets 15, said armature will respond to the magnetic energy of the indicating-magnets 14 and will make the final movement of the controller-bar, as fully described in my aforementioned pending application. It will now be seen that a normal movement of a unit of the system is identical with that described in my said pending application and the path of the current is substantially the same, with the exception that the current passes through the tongues 21, 21^a, and 21^b of the cut-out magnets 20, 20^a, and 20^b in series.

While a reverse movement of the switch B involves substantially the same movements just described, I will briefly trace the circuits. The controller being moved by the operator, brush 6 will bridge contacts 8 and 9, and brush 7 will bridge 11 and 12. Current will then flow from battery 5 through wire 23, contact 22, tongue 21, wire 24, contact 22^a, tongue 21^a, wire 25, contact 22^b, tongue 21^b, wires 26 27 28 29 30 31, contact 32, tongue 33, contact 34, wire 35, safety-magnets 15, wires 36 140, contact 11, brush 7, contact 12, wire 62, magnet 57, wire 61, contact 55, switch-arm 4, wire 42, armature 1, wire 41, switch-arm 3, contact 44, wire 45, field-coils 2, and wires 46 51 52, back to battery. This produces the movement of the armature 50, as above described, but in the direction to engage the stop 48 of the bar 47, energizes the safety-magnets to release the controller-bar, and also breaks contact through the contact-plate 78 and makes contact through the plate 67 for the next movement. As soon as the rail-switch has been moved and locked the switch-arms break contact with 44 and 55 and make contact with contact-points 53 and 54, respectively. Current then flows from battery through the path just described to contact 55, and from thence flows through wire 60, contact 54, switch-arm 4, wire 42, armature 1, wire 41, switch-arm 3, contact 53, wire 59, contact 40, wire 39, magnet 58, wire 38, contact 9, brush 6, contact 8, wires 76 64 65, indicating-magnets 14, connection 66, contact-piece 67, contact 68, wire 69, cut-out magnet 16, wires 70 71 72 52, back to battery. This results in the final movement of the controller, as above described.

I will now describe the function of the magnets 20, 20^a, and 20^b. Assume a cross to exist between the wire 38 and the wire 38^a, and assume it is desired to repeat the movement first above described. When the controller is moved so that the brushes 6 and 7 bridge the contacts 9 10 and 12 13, respectively, current will flow from the battery through wire 23, contact 22, tongue 21, wire 24, contact 22^a, tongue 21^a, wire 25, contact 22^b, tongue 21^b, wires 26 27 28 29 30 31, contact 32, tongue 33, contact 34, wire 35, safety-magnets 15, wires 36 37, contact 10, brush 6, contact 9, wire 38 to cross, and thence through cross to wire 38^a, contact 9^a, brush

6ª, contact 8ª, wires 76ª 64ª 141ª, contact 77ª, contact-piece 78ª, contact 79ª, wire 80ª, magnet 20ª, wires 81ª 82 71 72 52, back battery. This energizes the magnet 20ª and moves the tongue 21ª out of contact with the contact-point 22ª. This cuts off the battery entirely from both units—that is, the mechanism for moving the switch A and the mechanism for moving the switch B. It will therefore be seen at once that the moment a cross exists between any two wires leading to opposite poles of the battery one of the magnets 20 20ª 20ᵇ, &c., will be energized and the battery-current will be cut off. If a cross were between the wires 38 and 62, the magnet 20 would be in similar manner energized and the current cut off between the contact 22 and the tongue 21. If a cross existed between the two wires leading from the signal-controller to the signal-motor, the circuit would be broken through the energizing of the magnet 20ᵇ. In like manner a cross between an active wire of any unit and a wire of any other unit leading to the opposite pole of the battery will be cut off through the corresponding magnet, which will be in the circuit of said other wire leading to the opposite pole of the battery in whatever unit that wire may be. It will be evident that since the energy of the battery 5 flowing normally through the safety-magnet and the motor of the unit, and that since a current flowing from a cross through the magnets 20 20ª 20ᵇ has only to lift a tongue of one of said magnets, the normal leg of the safety-magnet will always give sufficient time after the circuit is closed through the controller and before the circuit of the magnets 20 20ª 20ᵇ can be broken by the response of the armature of the safety-magnet to the normal energization for the magnets 20 20ª 20ᵇ to open the circuit of the battery 5 in the event of a cross. It will also be seen that in the normal movement of any unit, since there is a cut-out magnet 16 16ª 16ᵇ, &c., one to each unit, each unit stands substantially alone, and may be operated independently or simultaneously with any other unit, provided no cross exists; but that as soon as a cross does exist all units involved in the system will be cut out.

The magnets 20 20ª 20ᵇ, and their tongues 21 21ª 22ᵇ, should be so positioned that when once a tongue is moved by its magnet it will remain out of contact until the cross is removed and then replaced by hand; otherwise the tongue might act as an interrupter and ultimately permit sufficient flow of current through the safety-magnets (if the cross were between the operating and indicating wire of the same unit) to break connection through the contacts 77 and 79 and the contact-plate 78, and thus permit a movement while a cross exists.

Having now shown how the first two points of my invention are attained—namely, the independent simultaneous operation of two or more units of a system and the cutting off of the battery in the event of a cross between any wire leading from one pole of the battery with the wire leading to the opposite pole—it now remains to show the means whereby I am able to hold a signal at reverse pending a cross between two wires as aforesaid, taking place after the signal has gone to be reverse. The necessity of such means will at once be understood, since in the operation of a large number of units a minor cross between two unimportant units of the system may otherwise operate to throw all of the signals to red and cause unnecessary and expensive delay. Assume that it is desired to move the signal C to reverse. The controller is moved so that the brush 106 bridges the contacts 119 and 111 and the brush 107 bridges the contacts 113 and 118. This closes a circuit including the battery 5 and the motor 101 102, so that current flows through wire 23, contact 22, tongue 21, wire 24, contact 22ª, tongue 21ª, wire 25, contact 22ᵇ, tongue 21ᵇ, wires 26 27 83, contact 32ᵇ, wire 33ᵇ, contact 34ᵇ, wire 84, safety-magnets 115, wires 85 86, contact 119, brush 106, contact 111, wires 87 88 89, motor-armature 101, field 102, wire 90, contact 91, brush 103, contact 92, wires 93, 94, 51, and 52, back to battery 5. This energizes the motor 101 102, causing it to move the signal to reverse and breaks the electrical connection of contacts 77ᵇ and 79ᵇ through contact-piece 78ᵇ and makes electrical connection between 67ᵇ and 68ᵇ. When the signal-blade has gone to full reverse, it will cause the throw of the snap-switch 103, as fully described in my aforementioned pending application, so that it will make contact with the contact-pieces 95 and 96. Current will then flow through the path just above described to the point of union between the field 102 and the wire 97, and from thence it will flow through wire 97, brake-magnet 104, wire 98, contact 95, snap-switch 103, contact 96, wires 99 100 121, contact 118, brush 107, contact 113, wires 122 123, indicating-magnets 114, flexible connection 66ᵇ, contact-plate 67ᵇ, contact-point 68ᵇ, wire 69ᵇ, cut-out magnet 16ᵇ, wire 70ᵇ, and wires 124 125 126 82 71 72 52, back to battery. This shunts the current around the safety-magnets and energizes the brake-magnet to hold the signal at reverse and energizes the indicating-magnets to cause the final movement of the controller-bar, as fully described in my aforesaid patent, which results in moving the brushes 106 and 107 so that they make contact with the contact-plates 110 111 and 117 118, respectively. This causes the current to flow from battery 5 through wire 23 outside of the cut-out magnets 20, 20ª, and 20ᵇ, through the wire 127 to the contact 110, brush 106, contact 111, wires 87 88 89, armature 101, field 102, wire 97,

brake-magnet 104, wire 98, contact 95, snap-switch 103, contact 96, wires 99 100 121, contact 118, brush 107, contact 117, wires 128 129 124 125 126 82 71 72 52, back to battery. Thus if a cross should exist between two wires leading to opposite poles of the battery while the signal C is set at reverse, since the current from the battery is carried outside of magnets 20 20^a 20^b, &c., and returns through the main common back to the opposite pole of the battery, it will not be effected by such cross; but it will be noted that it would be effected upon any attempt to move the signal C from normal to reverse if it were involved in the cross. I will also show how a cross between an active wire and a wire of a signal leading to the opposite pole of the battery will be detected upon the return of the signal to normal and the attempted return of the controller to normal. Suppose the signal C to be set at reverse and suppose the indicating-wire 88 to have become crossed with an active wire of another unit, since the signal went to reverse—as, for example, with the wire 38^a. To return the signal to normal, the operator would move the brushes 106 107 to bridge 109 119 and 112 113, respectively. This will close a circuit of the battery 5, so that current will flow through wire 23, contact 22, tongue 21, wire 24, contact 22^a, tongue 21^a, wire 25, contact 22^b, tongue 21^b, wires 26 27 83, contact 32^b, tongue 33^b, contact 34^b, wire 84, safety-magnets 115, wires 85 86, contact 119, brush 106, contact 109, wires 138 129 124 125 126 82 71 72 52, back to battery. If a cross existed when this circuit was established between the indicating-wire 88 and the active wire 38^a, as soon as the brushes 106 and 107 were moved to bridge the contacts, as above stated, and before the battery could sufficiently energize the magnets 115 to produce release of the controller, current would flow from the cross to wire 88, thence to wire 136, contact 112, brush 107, contact 113, wires 122 139, contact 77^b, contact-plate 78^b, contact 79^b, wire 80^b, magnet 20^b, wires 81^b 125 126 82 71 72 52, back to battery 5. This would energize the magnet 20^b and break the operating-circuit through the tongue 21^b and the contact 22^b. Since this would prevent the safety-magnets 115 from releasing the controller-bar for final movement the mechanical interlocker would lock up all conflicting lines. If no cross exists, the current traversing the path just described will energize the safety-magnets 115, break the electrical connection of contacts 77^b and 79^b with the contact-plate 78^b and move the brushes 106 and 107 to bridge contacts 108 119 and 112 113, respectively. The signal in the meantime going to normal will cause the brush 116 to make contact with the plate 105, and this will establish a circuit so that current will flow from battery 5 through the path just described to brush 106, and from thence through contact 108, wires 130 100 131, contact-plate 105, brush 116, flexible connection 132, wires 133 88 136, contact 112, brush 107, contact 113, wires 122 123, indicating-magnets 114, connection 66^b, contact-plate 67^b, contact 68^b, wire 69^b, cut-out magnet 16^b, and wires 70^b 124 125 126 82 71 72 52, back to battery. This shunts the circuit around the safety-magnets through the wire 74^b, contact 73^b, tongue 33^b, and wire 75^b, and permits the indicating-magnets to cause the final movement. Thus I attain the third point of my invention. It now remains to explain why I employ the contact-pieces 67 and 77 in connection with the contact-points 68, 77, and 79, respectively. It will be noted that upon the initial movement the current is taken through the safety-magnet and goes back to battery through the common return-wire, and does not pass back through the controller. If it did, it would pass back through the magnet 20 or 20^a or 20^b, as the case may be. Since it does not, except in the event of a cross, the movement of the armature 56 or 56^a or 56^b, as the case may be, will close the circuit for the return through the controller and the safety-magnets before that circuit is established by the pole-changing switch, and at the same time will break the possible circuit through the magnets 20, 20^a, or 20^b by removing the contact-piece 78 or 78^a or 78^b from the contacts 77 and 79 or the contacts 77^a and 79^a or 77^b and 79^b. By this construction the separateness of the several units of the system is entirely maintained, and at the same time the interdependence in the event of a cross is entirely established.

Having thus described my invention and its method of operation, what I claim is—

1. In combination with a source of electric energy, operating and indicating wires, a return-wire, a motor, a controller, means for shunting the operating-current from the return-wire to the indicating-wire, and means for opening the operating-wire in the event of a cross between the indicating-wire and any active wire.

2. In combination with a source of electric energy, operating and indicating wires, a common return-wire, a motor, a controller, means for shunting the battery-current from the common return-wire through the indicating-wires, a conductor common to all operating-wires, means for opening said conductor common to all operating-wires in the event of a cross of any indicating-wire with any active wire.

3. In combination with a source of electric energy, a plurality of motors, operating and indicating wires, a plurality of controllers, a common return-wire, a conductor common to all operating-wires, means in each unit for shunting the battery-current from the common return-wire through the indicating-wire

of the unit, means for opening the conductor common to all operating-wires in the event of a cross between any indicating-wire and any active wire.

4. In combination with a source of electric energy, a conductor common to all operating-wires, a common return-wire, means for operating a plurality of motors independently and simultaneously, comprising, for each motor or unit, operating and indicating wires, a controller, means for shunting the battery-current through the indicating-wire, means for opening the conductor common to all operating-wires in the event of a cross between any indicating-wire and any active wire.

5. In combination with a source of electric energy, a common return-wire, a conductor common to all operating-wires, a conductor common to all indicating-wires, a plurality of motors, controllers, means in connection with each motor for shunting the current from the common return-wire through the indicating-wire of the unit, safety-magnets in the operating-circuits, indicating-magnets in the indicating-circuits, cut-out magnets in the indicating-circuits for shunting the operating-current around the safety-magnets, and a common wire connecting said cut-out magnets with said battery.

6. In combination with a source of electric energy, a common return-wire, a conductor common to all operating-wires, a conductor common to all indicating-wires, a plurality of motors, controllers, means in connection with each motor for shunting the current from the common return-wire through the indicating-wire of the unit, safety-magnets in the operating-circuits, indicating-magnets in the indicating-circuits, cut-out magnets in the indicating-circuits for shunting the operating-current around the safety-magnets, and a common wire connecting said cut-out magnets with said battery, means for opening the operating common in the event of a cross of an active wire with any indicating-wire, comprising, an electric switch in said operating common for each unit, a magnet for each unit governing its respective switch, means for closing said last-mentioned magnets in circuit with the indicating-wire, and means for cutting out each of said last-mentioned magnets during the time the safety-magnet of its unit is energized.

7. In a railway switching and signaling system, a common source of electric energy, a common return-wire, a conductor common to all operating-wires, a motor for each unit, a controller for each unit, operating and indicating wires for each unit, means in each unit for shunting the current from the common return to the indicating wire of the unit, safety-magnets in the operating-circuit of each unit, indicating-magnets and cut-out magnets in the indicating-circuit of each unit, a common wire connecting said cut-out magnets with said battery, whereby said units may be operated independently or simultaneously.

8. In a railway switching and signaling system, a common source of electric energy, a common return-wire, a conductor, common to all operating-wires, a motor for each unit, a controller for each unit, operating and indicating wires for each unit, means in each unit for shunting the current from the common return to the indicating wire of the unit, safety-magnets in the operating-circuit of each unit, indicating-magnets and cut-out magnets in the indicating-circuit of each unit, a common wire connecting said cut-out magnets with said battery, whereby said units may be operated independently or simultaneously, and means for breaking said operating common in the event of a cross between any indicating-wire with any active wire leading from the opposite pole of the battery, comprising, an electric switch to each unit of the system cut in to the operating common, magnets for opening said electric switches when said magnets are energized, means for closing said magnets in the indicating-circuits at all times excepting when said safety-magnets are energized, whereby, a normal current passing through an indicating-wire will not operate said electric switch and whereby an abnormal current passing through any indicating-wire will energize a magnet governing an electric switch in the operating common and cut off the battery from the entire system.

9. In combination with a source of electric energy, a switch-motor, a controller, wires operating alternately as operating and indicating wires, a common return-wire, a controller, a safety-magnet, an indicating-magnet, a cut-out magnet, a pole-changing switch, means for shunting the current from the common return to the indicating wire by a partial throw of said pole-changing switch, an electric switch in the operating-wire, a magnet governing said electric switch, a circuit connecting said magnet governing said switch with the indicating-wire and the battery, means for breaking the circuit of the magnet governing said switch as soon as the safety-magnets are energized, and means for including the cut-out magnet in the indicating-circuit when said safety-magnets have been energized.

10. In combination with a source of electric energy, a signal-motor, a controller, an operating-wire, an indicating-wire, a common wire, a safety-magnet, an indicating-magnet, a cut-out magnet, means for shunting the current from the common wire to the indicating-wire, an electric switch in the operating-wire, a magnet governing said electric switch, a circuit connecting said magnet governing said switch with the indicating-

wire and the battery, means for breaking the circuit of the magnet governing said switch as soon as said safety-magnet is energized, and means for including the cut-out magnet in the indicating-circuit when said safety-magnets have been energized.

11. In combination with a source of electric energy, a signal-motor, a controller, an operating-wire, an indicating-wire, a common wire, a safety-magnet, an indicating-magnet, a cut-out magnet, means for shunting the current from the common wire to the indicating-wire, an electric switch in the operating-wire, a magnet governing said electric switch, a circuit connecting said magnet governing said switch with the indicating-wire and the battery, means for breaking the circuit of the magnet governing said switch as soon as said safety-magnet is energized, and means for including the cut-out magnet in the indicating-circuit when said safety-magnets have been energized, and means for maintaining the signal at reverse position in the event of a cross between any indicating-wire of the system with any active wire eventuating in the opening of the operating common after the signal has been set at reverse, comprising contacts on said controller, wires connecting said contacts with the two poles of the source of energy outside of all other units, whereby the final throw of the controller-brushes establishes the signal mechanism in circuit with the battery independently of all other units.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

WILLIAM MACOMBER.

Witnesses:
A. W. MACOMBER,
E. F. BRANCH.