No. 821,385. PATENTED MAY 22, 1906.

J. D. TAYLOR.

RAILWAY SWITCHING AND SIGNALING APPARATUS.

APPLICATION FILED FEB. 10, 1903.

2 SHEETS—SHEET 1.

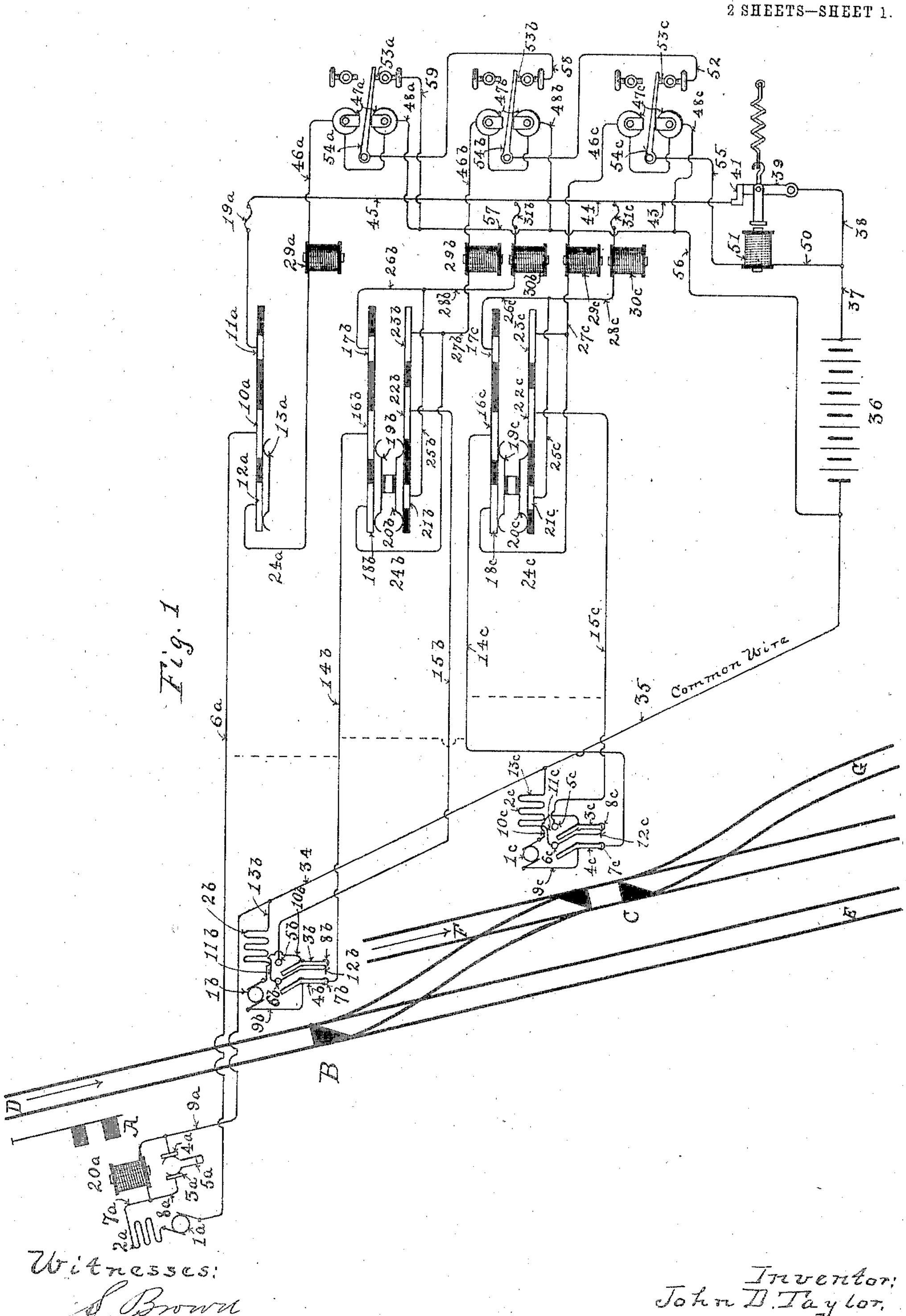

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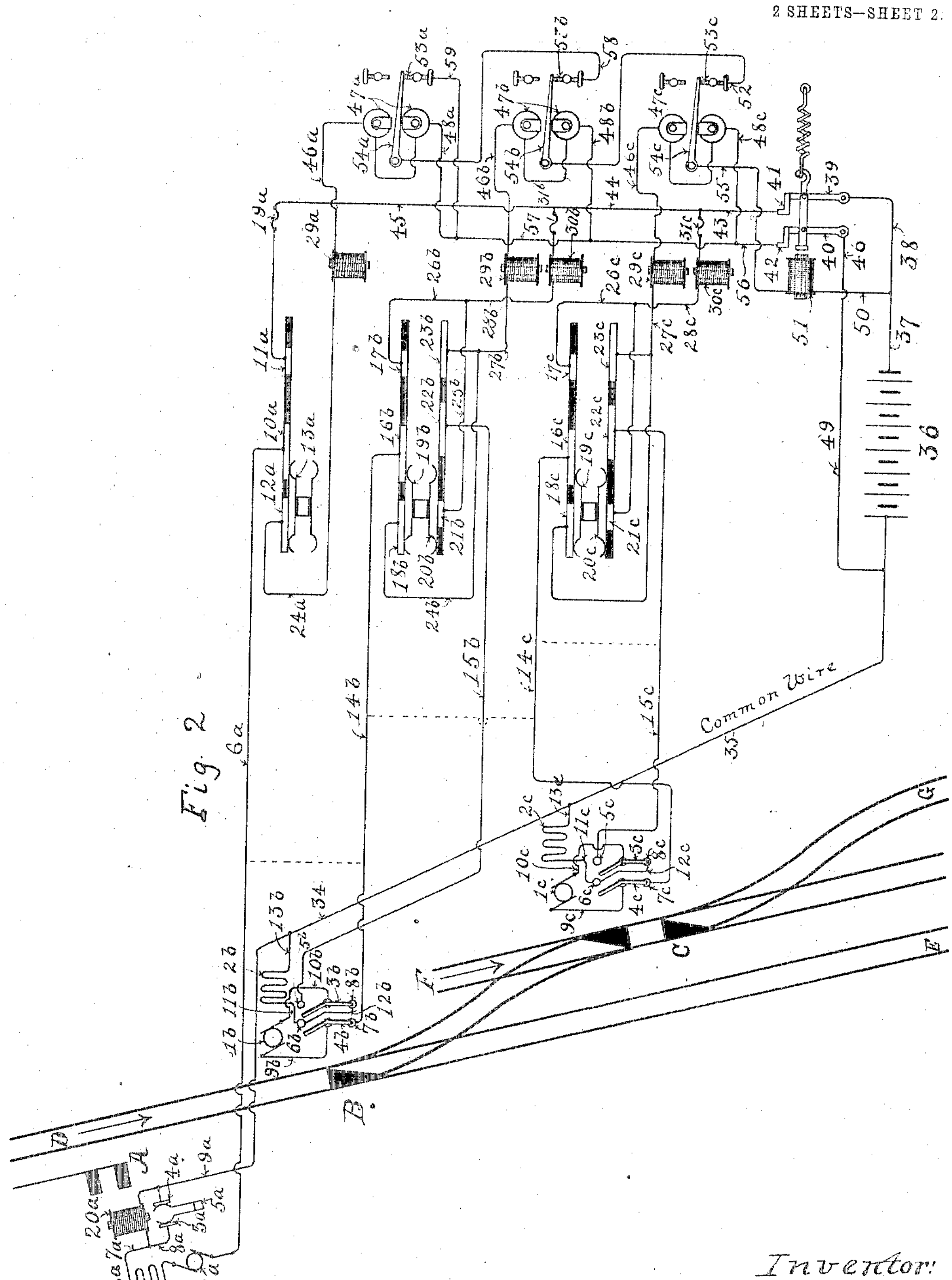
Fig. 2



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UNITED STATES PATENT OFFICE.

JOHN D. TAYLOR, OF BUFFALO, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL RAILWAY SIGNAL COMPANY, OF BUFFALO, NEW YORK, A CORPORATION OF NEW YORK.

RAILWAY SWITCHING AND SIGNALING APPARATUS.

No. 821,385. Specification of Letters Patent. Patented May 22, 1906.

Application filed February 10, 1903. Serial No. 142,729.

To all whom it may concern:

Be it known that I, JOHN D. TAYLOR, a citizen of the United States, residing at Buffalo, New York, have invented certain new and useful Improvements in Railway Switching and Signaling Apparatus, of which the following is a full, clear, and exact description.

This improvement relates to that class of apparatus in which electricity is the motive and controlling power; and the objects of this improvement are to guard against the bad effects of crossed wires and of an open common wire, to enable the operator to readily determine which wires are in trouble, and to reduce the effects of a fall in potential in the common wire on the safety apparatus itself. These objects are accomplished by the arrangement of apparatus and circuits shown in the accompanying diagram.

The construction and operation of the interlocking machine referred to is fully illustrated and described in my Patent, No. 605,359, June 7, 1898, and the reissue thereof, No. 707,181, August 19, 1902, and in my pending applications, Serial No. 42,994, filed January 12, 1901, and Serial No. 95,460, filed February 24, 1902. The signal-operating mechanism is fully set forth in my Patents No. 516,903, March 20, 1894; No. 707,180, August 19, 1902; No. 707,182, August 19, 1902. The switch-operating mechanism is fully illustrated and described in my Patents No. 554,097, February 4, 1896; No. 681,589, August 27, 1901; No. 707,181, August 19, 1902.

Figure 1 is a diagram of the circuits, showing a single switch or cut-out placed in the operating common. Fig. 2 is a similar diagram showing a double switch for breaking both the operating common and the indication common.

As illustrating typical means for carrying out my invention I have shown in the diagram at 36 a source of energy; at 1^a, 1^b, and 1^c electric motors for operating signals and switches, as described in the above-named patents. The parts having the suffix "a" are those connecting with the signal A and the parts having the suffixes "b" and "c" are those connecting with the switches B and C, respectively. The brushes 13, 19, and 20 and their respective contacts constitute the manually-operated controllers for the signal and switches. The brush 5 and the arms 3 and 4, with their respective contacts, constitute the automatically-operated controllers.

29 represents indication-magnets, and 30 represents safety-magnets operating as described in said aforementioned patents.

39 40 41 42 are parts of a two-pole electric switch. The parts 39 40 are held in contact with the parts 41 42, respectively, by the electromagnet 51, which is in a circuit capable of being closed with a battery.

47 represents polarized relays which control the circuit of the magnet 51.

The brush 13^a is connected to the signal-operating bar or lever and together with the contacts 10^a, 11^a, and 12^a form a controller for the operating and indication circuits of the signal. The brushes 19^b and 20^b, connected to a switch-operating bar or lever, together with the contacts 16^b 17^b 18^b 21^b 22^b 23^b, form a controller for the operating and indication circuits of switch B. The brushes and contacts of similar numerals, with the suffix "c," form a controller for the operating and indication circuits of switch C. The magnet 29^a is indication-magnet for signal A. The magnet 29^b is indication-magnet for switch B. The magnet 30^b is a safety-magnet corresponding to magnet designated 21 in my said former application, Serial No. 42,994. The magnets 29^c and 30^c, respectively, perform similar functions with reference to switch C. The magnet 20^a is the brake-magnet holding the signal clear when the signal-lever stands reversed.

This invention is, furthermore, an improvement upon the invention shown and disclosed in my Patent No. 759,327, issued May 10, 1904.

As set forth in the above-named patents, the switches and signals are operated by electric motors suitably geared to them and supplied with current from a battery or other generator located in the cabin or a suitably-located power-house, and the locking between the controlling-levers is governed by what are generally known as "indication-magnets," which magnets are operated by currents generated by the switch or signal operating motors themselves, which are for the purpose and for the time being converted into generators.

In the diagram two switch and one signal operating mechanisms are illustrated. It will be seen that one wire (designated as "common" wire) connects all the operating-motors with one pole of the battery, which for convenience I will call the "negative" pole. This wire is common to all indication-circuits, as well as all operating-circuits. In addition to this wire one wire leads from the interlocking machine to the signal-motor, which serves as operating-wire when the signal is "reversed" or put in clear position and as indication-wire when the signal is returned to "normal" or danger position by the counterweight, and two wires lead from the interlocking machine to each switch-motor, of which one is operating and the other indication wire; but these functions are reversed for opposite movements of the switch—that is, the wire that is operating-wire for "reverse" movements of the switch becomes indication-wire for normal movements, and the wire that is indication-wire on reverse movements becomes operating-wire on normal movements. From this it is clear that each indication-wire becomes operating-wire on the next movement of its corresponding mechanism and for this reason must be in connection with its corresponding motor to enable the operator to control it at will. For the same reason each operating-motor must be at all times in connection with the common wire. From this it is clear that if one of these indication-wires is crossed with any active wire current will be supplied to its corresponding motor, and the switch or signal operated by it will be moved, and this would be equally true whether the wire is used for indication purposes or not. I prevent this occurrence in the following manner and by the means hereinafter described.

I construct the controller connected to and operated by the controlling-lever so that the indication-wires remain normally in connection with the common wire—that is, so that the indication-circuit is not broken by the final movement of the lever after indication. It is immaterial to the operation of this invention whether the controller is constructed to open the operating-circuit on the final movement of the lever after indication, as shown in the diagram of this application, or leaves it normally in connection with the battery, as shown in my said pending application, Serial No. 95,460. I control the operating and indication circuits by means of a double-pole magnetic cut-out, using one of its switch-arms to control all operating-circuits by inserting it in a branch common to all operating-circuits, and the other switch-arm is inserted in a branch common to all indication-circuits. This magnetic cut-out may be of any of the well-known types suitable for the purpose and needs no further description. As heretofore stated and as shown in the drawings, a single switch may be employed in the common wire leading to either pole of the battery, and this will be clearly understood from a description of the construction of Fig. 2, wherein switches are placed in both wires. I control this magnetic cut-out by means of polarized relays, one for each switch and signal to be operated. The coils of these relays are placed, respectively, in the indication-circuits of the corresponding switches or signals, and consequently form part of the connections between the indication-wires and the common wire, so that any current supplied to an indication-wire from the positive of the battery will find its way back to the negative of the battery through the corresponding relay. The circuit of the magnet which holds the cut-out switches in place is taken in series through the relay-tongues, so that if any relay-tongue is thrown away from its contact-piece the magnet-circuit is opened and the switches are withdrawn from their respective contacts by a spring. These polarized relays may be of any of the well-known types and, as is well known, may be adjusted so that the tongue will remain against either the forward or back stop even after the current which put it there has subsided. For the purposes herein mentioned they should be so adjusted.

The current which drives the signal-motor on "reversing" the signal turns the armature in such direction as to lift the counterweight. When the signal-lever is put normal, thereby cutting off the connection with the battery and connecting the operating-wire to the common wire through the indication-magnet and one of the polarized relays, the motor is on a closed circuit independent of the battery. The counterweight then drives the armature in a reverse direction, and the electromotive force induced by the field-magnets is reversed, thus causing a current to flow in the same direction through the field-magnet coils and through the common wire as that in which the battery-current previously flowed—that is, the current flows from the signal-motor through the common wire, the wire 49, switch-arm 40, contact 42, wires 56 57 48^a, coils of the relay 47^a, wire 46^a, indication-magnet 29^a, wire 24^a, contact 12^a, brush 13^a, contact 10^a, wire 6^a, back to the signal-motor.

Assuming that the brushes and controllers are standing in the normal position to reverse the switch B—in other words, to set the railswitch for the crossover—the brush 19^b is put into contact with the contacts 16^b and 17^b, the brush 20^b being at the same time put in connection with the contacts 22^b and 23^b. This movement of the controller establishes a circuit of the battery 36, so that the current flows through the wires 37 38, switch-arm 39, contact 41, wires 43 44, fuse 31^b, magnet 30^b, wire 26^b, contact 17^b, brush 19^b, contact 16^b, wire 14^b, contact 7^b, switch-arm 4^b, wire 9^b, back through the common wire to the battery; but since the resistance of the indication-magnet and polarized relay combined is less than that of the switch-operating motor and their combined inductance is very much less by far the larger part of the current will return through the polarized-relay coils. Now if the polarized relay is so adjusted that a smaller amount of current is required to throw the tongue away from its forward stop than is required to move a switch or signal operating motor the arrangement will be perfectly safe, as the relay and magnetic cut-out are both practically instantaneous in their action. If, instead of the signal-lever, the lever of switch B had been reversed, the circuit would have been from battery 36, through wires 37 38, switch 39, contact 41, wires 43 44, magnet 30^b, wire 28^b, wire 26^b, contact 17^b, brush 19^b, contact 16^b, wire 14^b, through the cross connection to wire 6^a, to contact 10^a, brush 13^a, contact 12^a, wire 24^a, indication-magnet 29^a, wire 46^a, relay-coils 47^a, wires 48^a 57 56, contact 42, switch 40, wire 49, back to battery 36. This throws the relay-tongue 54^a away from the stop 53^a and opens the circuit of the magnet 51, as before, but in another place.

The reading of the circuits upon the diagram of Fig. 1 will be exactly the same as above described, with the exception that currents flowing from the wire 56 back to battery through the contact 42, arm 40, and wires 46 49, as in Fig. 2, the wire 56 is continued to and connects directly with the battery 36. It is also to be noted that while I have shown a relay to each switch or signal it is not necessary to employ a single relay for each separate switch or signal in all cases, since a number of switches or signals or switches and signals may be grouped together and be controlled through a single relay. By this construction we would simply have two or more mechanisms connected with a single relay and two or more mechanisms connected with another relay, thus grouping the mechanisms and reducing the number of relays, but in no wise departing from the spirit of my invention, since this would reduce the current by division of paths, so that the end sought would be attained.

When the cut-out opens simultaneously with the movement of a lever, it is evident that the wire connected to that lever is one of the wires in trouble, and an inspection of the line of relays will show the other one, as it will be one corresponding to the relay found open. When a switch-lever is concerned in the trouble, the position of the lever determines which of the two wires leading to that switch is crossed. The cut-out might be opened by the grounding of two wires on the frame of the interlocking machine and when none of the levers is being moved. In that case the relay will indicate one of the points of trouble and the other will have to be searched for, but to be able to find and remove one of the grounds is a great advantage, as the removal of one destroys the cross and will permit the machine to be operated with safety. If the common wire is broken, say, between the cabin and the first switch and the lever of signal A is reversed, current from the battery will pass out through the wire 6^a, the signal-operating motor to the common wire, and as the switch-operating motors are in connection with the common wire and with their respective indication-wires and through them and their respective relays with the negative end of the battery the signal-operating current will return through the switch-motors, through the switch-indication wires, and polarized relays back to the battery. As this return-current is divided between two or more paths, depending on the number of other switches and signals in connection with the piece of the common wire to which the signal being operated is connected, this current may or may not be enough to open the relays through which it passes; but since these relays are adjusted to open on a smaller current than is sufficient to move a switch or signal motor if the current is not strong enough to open the relays it is not strong enough to move the corresponding motors and no harm will be done. In fact, a large plant might be operated with a broken common wire and with perfect safety. If, however, the return-paths are so few in number that the current through the relays is strong enough to open them, the cut-out will be open in the same manner as described for crossed wires. Two or more relays being opened simultaneously would indicate that the common wire might be broken, although such condition might be caused by a number of wires being crossed or grounded. To determine which of these conditions actually exists, an ammeter could be placed in the common wire just outside of its connection with the wire 49.

Since opening an electric circuit is equivalent to introducing an infinite resistance into the circuit, the breaking of the common wire would be equivalent to making its resistance infinite, and since the fall in potential in any wire due to any given current is proportional to the resistance the fall of potential in the common wire due to the operation of a switch or a number of switches would tend to send a current back through the indication-wires of the other switches and would act on their corresponding polarized relays in a similar manner to but to a much less extent than a broken common wire. If only one relay were used for the entire plant, the entire volume of current returning through the above-named paths might easily be sufficient to cause it to open the magnetic cut-out. By the use of a separate relay for each separate switch and signal the return current due to armature of switch-operating motor 1^b, wire 10^b, switch-arm 3^b, contact 8^b, wires 12^b 11^b, field-coils of switch-operating motor 2^b, wire 13^b, wires 34 35, back to battery 36. This current causes rotation of the motor 1^b and movement of the switch-rails. When the movement is completed and the rail-switch locked, the switch-arms 3^b and 4^b are shifted from the contacts 8^b 7^b, respectively, to the contacts 5^b 6^b, respectively, thus opening the circuit just described and establishing a new one, including the motor 1^b, the indication-magnet 29^b, and the polarized relay 47^b, so that the current generated by the continued rotation of the armature flows from the armature 1^b, through wire 9^b, switch-arm 4^b, contact 6^b, wire 11^b, field-coils 2^b, wires 13^b 34 35 49 46, switch-arm 40, contact 42, wires 56 48^b, coils of relay 47^b, wire 46^b, indication-magnet 29^b, wire 27^b, contact 23^b, brush 20^b, contact 22^b, wire 15^b, contact 5^b, switch-arm 3^b, wire 10^b, back to the armature 1^b. This current energizes the indication-magnet 29^b to permit final movement of the switch-operating bar. This current flows through the coils of the relay 47^b in such direction as to tend to hold the tongue 54^b against the active stop 53^b.

To put the switch B normal—in other words, to set the switch-rail for the main track—the operating-bar is moved so as to cause the brush 19^b to make connection with the contacts 16^b and 18^b and the brush 20^b makes connection with the contacts 22^b and 21^b. This causes a current of the battery to flow through the wires 37 38, switch-arm 39, contact 41, wires 43 44, fuse 31^b, safety-magnet 30^b, wire 28^b, wire 25^b, contact 21^b, brush 20^b, contact 22^b, wire 15^b, contact 5^b, switch-arm 3^b, wire 10^b, armature of switch-operating motor 1^b, wire 9^b, switch-arm 4^b, contact 6^b, wire 11^b, field-coils of motor 2^b, wires 13^b 34 35 back to the battery 36. This energizes the motor and returns the rail-switch to normal. The final movement of the lock-bolt moves the switch-arms 3^b 4^b, so as to separate them from the contacts 5^b and 6^b, respectively, and put them into connection with the contacts 8^b and 7^b, respectively. This breaks the battery-circuit last named and establishes a new one, including the motor, indication-magnet, and relay, so that the current generated in the switch-motor armature flows from the armature 1^b through the wire 10^b, switch-arm 3^b, contact 8^b, wires 12^b 11^b, field-coils 2^b, wires 13^b 34 35 49 46, switch-arm 40, contact 42, wires 56 48^b, coils of relay 47^b, wire 46^b, indication-magnet 29^b, wires 27^b 24^b, contact 18^b, brush 19^b, contact 16^b, wire 14^b, contact 7^b, switch-arm 4^b, wire 9^b back to the armature 1^b. This current energizes the indication-magnet 29^b, as before, to permit final movement of the operating-bar. It also flows through the coils of the relay 47^b in the same direction as the first-described indication-current—that is, in such direction as to tend to hold the tongue 54^b against the active stop 53^b.

I have merely traced enough of the circuits in the above to show the direction of the indication-currents, that it is the same for switches and signals, and that the flow through the common wire is in the same direction as the battery-currents and through the indication-wires in the same direction as the battery-current flows through them when they are operating-wires.

The switch-arms 39 and 40 are held normally against their respective stops 41 42 by the electromagnet 51. The circuit of this magnet is such that the current from the battery 36 flows through the wires 37 50, magnet 51, wire 55, relay-tongue 54^c, stop 53^c, wire 52, relay-tongue 54^b, stop 53^b, wire 58, relay-tongue 54^a, stop 53^a, wires 59 57 56, contact 42, switch-arm 40, wire 49 back to battery 36. The relay-tongues 54 are held normally against stops 53 by the permanent magnets, so long as no current is flowing in the coils 47. Current in the coils 47 in the direction of the indication-currents noted above also tends to hold the tongues 54 against the stops 53. Consequently so long as no current is flowing in the coils 47 or current is flowing in the direction of the indication-currents the circuit of the magnet 51 will remain unbroken, and the switches 39 and 40 will be held against the stops 41 and 42. Now suppose the wires 6^a, in operative connection with a signal-motor, and the wire 14^b, in operative connection with a switch-motor, should be connected or crossed, as shown by the dotted line, and the signal-lever is reversed, putting the brush 13^a into connection with contacts 10^a and 11^a. Current from the battery 36 would then flow through the wires 37 38, switch 39, contact 41, wires 43 44 45, fuse 19^a, contact 11^a, brush 13^a, contact 10^a, wire 6^a, through the cross-connection, to wire 14^b, contact 16^b, brush 19^b, contact 18^b, wires 24^b 27^b, indication-magnet 29^b, wire 46^b, relay-coils 47^b, wire 48^b, wire 56, contact 42, switch 40, wire 49 back to battery 36. It will be noticed that this current flows through the relay-coils 47^b in the opposite direction to that of the indication-current mentioned above. It therefore has the effect of throwing the tongue 54^b away from the stop 53^b and against the back stop, where it remains until put back by the operator. The separation of tongue 54^b and stop 53^b opens the circuit of the magnet 51, which allows the switches 39 and 40 to be drawn away from their contacts 41 and 42, thus opening the operating and indication circuits, cutting off the supply of current from the wire 14^b, and thus preventing the switch B from being moved. Of course a part of the current which reaches the wire 14^b through the cross connection passes out through the switch-motor and fall in potential is divided between as many relays as there are return-paths, and the current through any one of the relays will not be sufficient to open it, and still the common wire need not be larger than required to carry the operating-currents with the efficiency usually allowed in such work.

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

1. In combination with controllers, switch and signal apparatus, operating and indication circuits, a conductor common to all operating and indication circuits, a conductor common to all operating-circuits, a conductor common to all indication-circuits, a magnetic cut-out for breaking the operating common or the indication common, a circuit for said cut-out, polarized relays, one for each switch and one for each signal, or groups of switches or signals, having their coils in the indication-circuits of their respective switches and signals, the circuit of the magnetic cut-out taken in series through the tongue of said relays, whereby a cross between any operating-wire and any indication-wire will cause a reverse current to flow through the coil of the relay of the indication-wire involved to open the cut-out circuit and thus break the circuit involved in the cross, substantially as and for the purposes set forth.

2. A source of electric energy, a plurality of motors, a plurality of controllers, a plurality of polarized relays, conductors connecting each of said motors through the energizing-coil of a polarized relay to one pole of the source of energy, and a wire connected to the other pole of the source of energy, a switch in said wire, a circuit governed by said relay, a magnet and a source of energy in said circuit governing said switch, whereby a cross between said last-named conductors will cause a current to flow through the coils of the relay in circuit with the wire crossed in the direction to cause the relay to open the circuit of said magnet, and thereby causing said switch to open, substantially as and for the purposes set forth.

3 In combination with controllers, switch and signal apparatus, operating and indication circuits, a conductor common to all circuits, a conductor common to all operating-circuits, a conductor common to all indication-circuits, a double-pole magnetic cut-out for breaking both operating and indication circuits, a circuit for said cut-out, polarized relays, one for each switch and signal, having their coils in the indication-circuits of their respective switches and signals, the circuit of the magnetic cut-out taking in series through the tongues of said relays, all so arranged that a cross between any operating-wire and any indication-wire will cause a reverse current to flow through the coil of the relay of the indication-wire involved to open the cut-out circuit and thus break all operating and indication circuits involved, substantially as and for the purposes set forth.

4. In combination with controllers, switch and signal apparatus, operating and indication circuits, a magnetic cut-out for breaking all operating-circuits, polarized relays, a circuit including the tongues of said relays for energizing the magnet of said cut-out to hold the same normally closed, polarized relays corresponding to each switch and signal with their coils in circuit with their respective indication-circuits, and each relay arranged so that in the event of a cross of its circuit with any operating-circuit, a reverse current will flow through the coil of the relay of the indication-wire involved and cause it to open said magnetic cut-out, substantially as and for the purposes set forth.

5. In combination with controllers, switch and signal apparatus, operating and indication circuits, a conductor common to all operating and indication circuits, a conductor common to all operating-circuits, a conductor common to all indication-circuits, polarized relays in the indication-circuits, a double-pole magnetic cut-out for breaking both operating and indication circuits, a circuit including the tongues of the polarized relays governing said cut-out, all so arranged that currents flowing normally all flow through the magnets of said relays in one direction, and the direction to hold said relays closed, and so that any current due to cross or ground flowing therethrough will flow in reverse direction, and thus break the circuit of said magnet of said cut-out, substantially as and for the purposes set forth.

6. In combination with switch and signal apparatus, operating and indication circuits, a controller normally in connection with the common wire, a conductor common to all operating and indication circuits, a conductor common to all operating-circuits, a conductor common to all indication-circuits, a double-pole magnetic cut-out for breaking both operating and indication circuits, a circuit for said cut-out, polarized relays, one for each switch and signal, having their coils in the indication-circuits of their respective switches and signals, the circuit of the magnetic cut-out taking in series through the tongues of said polarized relays, all so arranged that a cross between any operating-wire and any indication-wire will cause a reverse current to flow through the relay of the indication-wire involved, and open the cut-out circuit, and thus break all operating and indication circuits involved, substantially as and for the purposes set forth.

7. In combination with switch and signal apparatus, operating and indication-circuits, polarized relays in the indication-circuits, controllers normally connecting the indication-wires with their respective relays, a conductor common to all operating and indica-

tion circuits, a conductor common to all operating-circuits, a conductor common to all indication-circuits, a double-pole magnetic cut-out for breaking both operating and indication circuits, a circuit including the tongues of the polarized relays governing said cut-out, all so arranged that currents flowing normally all flow through the magnets of said relays in one direction, and the direction to hold such relays closed, and so that any current due to cross or ground flowing therethrough will flow in reverse direction, and thus break the circuit of said magnet of said cut-out, substantially as and for the purposes set forth.

8. In combination with switch and signal apparatus, controllers normally connecting the indication-wires with their respective relays, a conductor common to all circuits, a conductor common to all operating-circuits, a conductor common to all indication-circuits, a double-pole magnetic cut-out for breaking both operating and indication circuits, a circuit including the tongues of the relays governing said cut-out, polarized relays in the indication-circuits, all so arranged that the currents flowing normally all flow through the magnets of said relays in one direction, and the direction to hold said relays closed, and so that any current due to cross or ground flowing therethrough will flow in reverse direction, and thus break the circuit of said magnet of said cut-out, substantially as and for the purposes set forth.

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

JNO. D. TAYLOR.

Witnesses:

EDWARD C. RISCHMAN,

A. W. MACOMBER.