No. 789,239. PATENTED MAY 9, 1905.

H. W. SOUDER.

ELECTRIC SIGNAL SYSTEM.

APPLICATION FILED MAY 26, 1904.

5 SHEETS—SHEET 1.

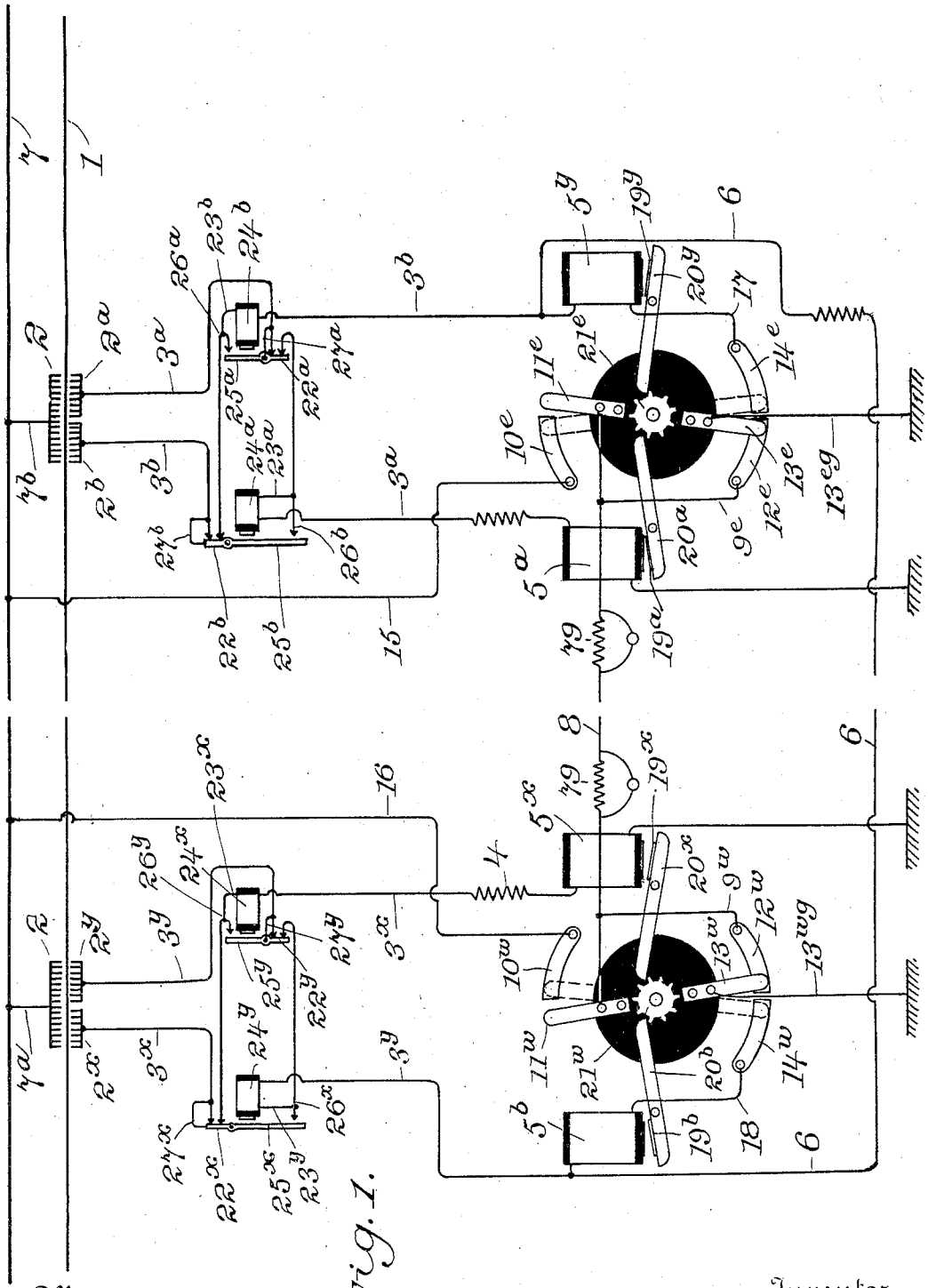

Fig. 1.

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5 SHEETS—SHEET 2.

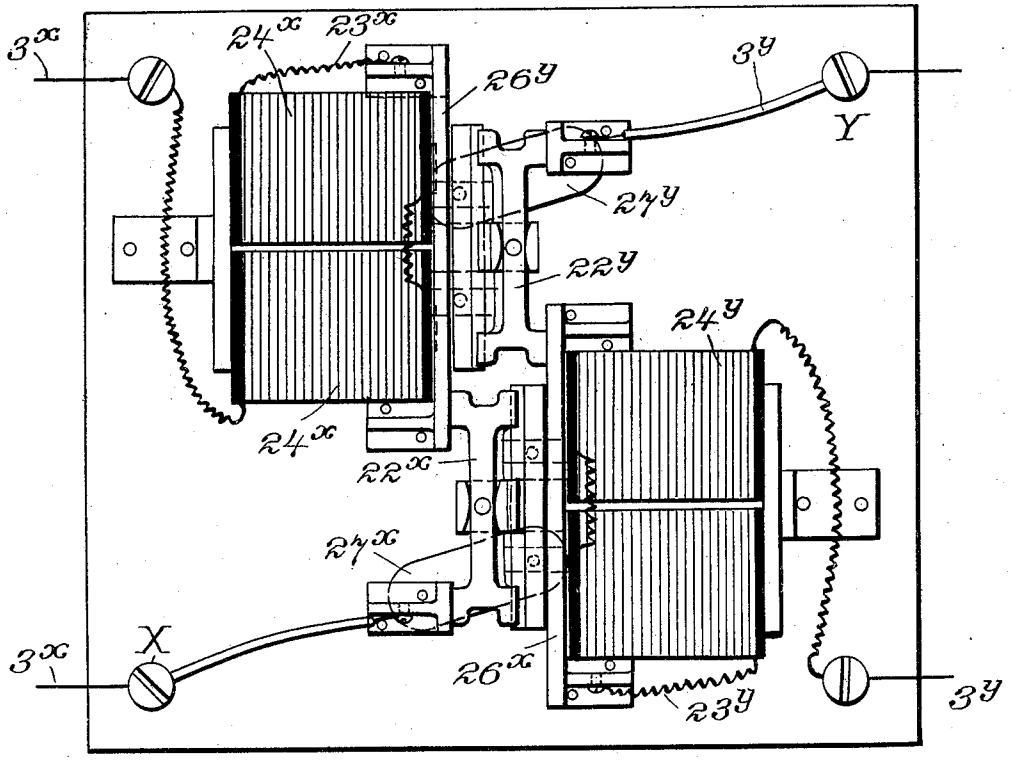
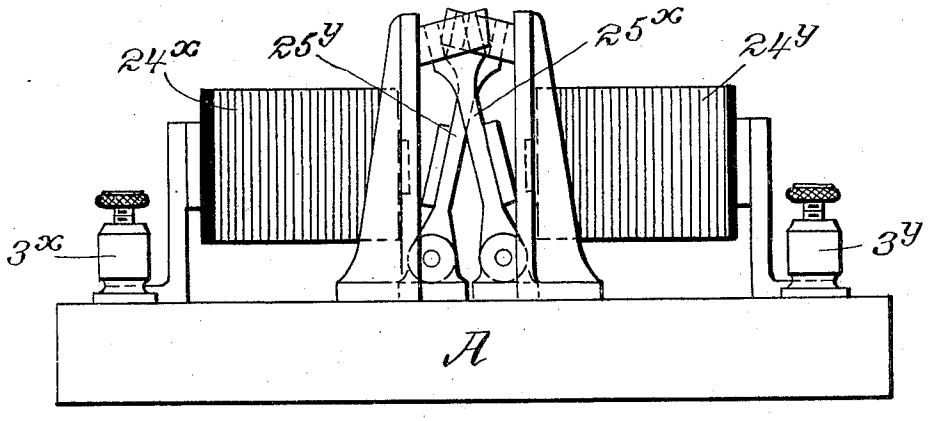


Fig. 2.

Fig. 3.



Witnesses

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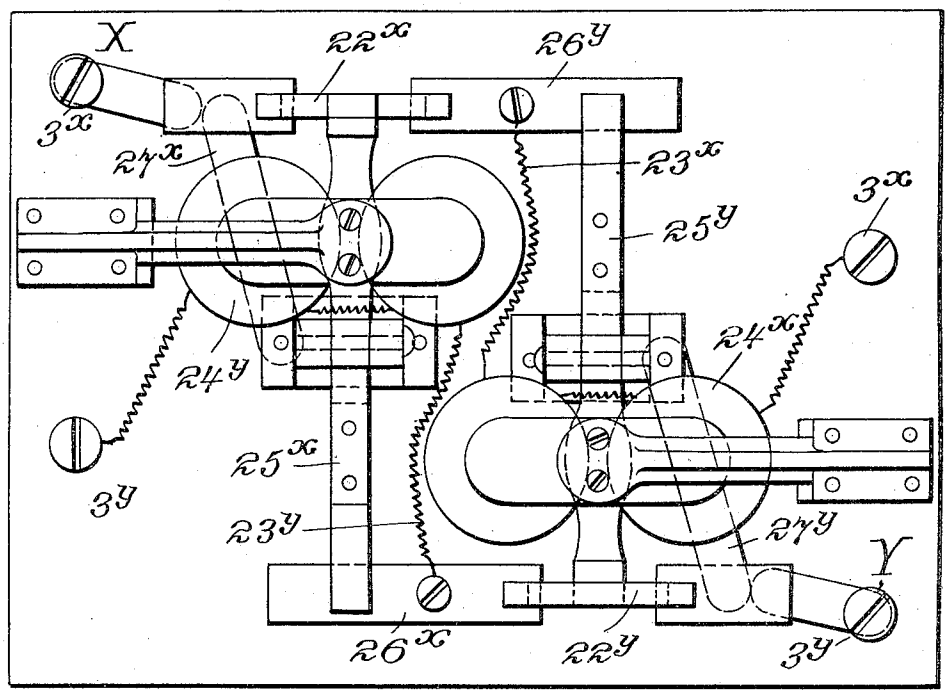
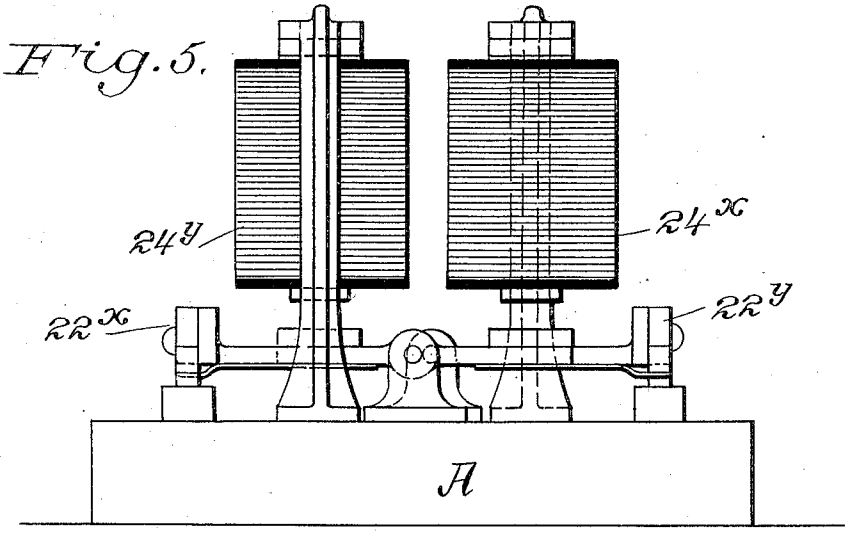


Fig. 4.

Fig. 5.



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5 SHEETS—SHEET 4.

Fig. 6.

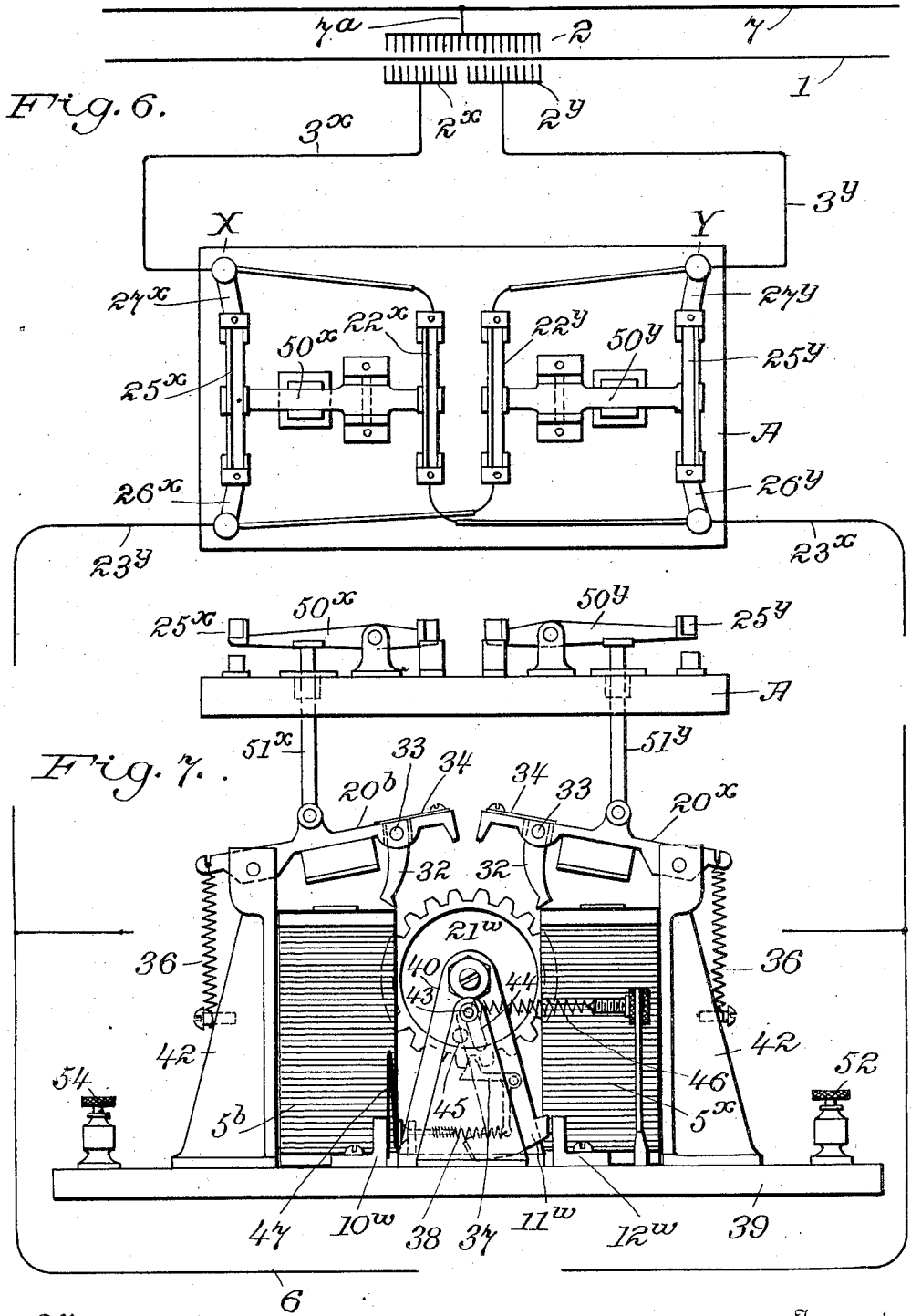

Fig. 7.

Witnesses

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5 SHEETS—SHEET 5.

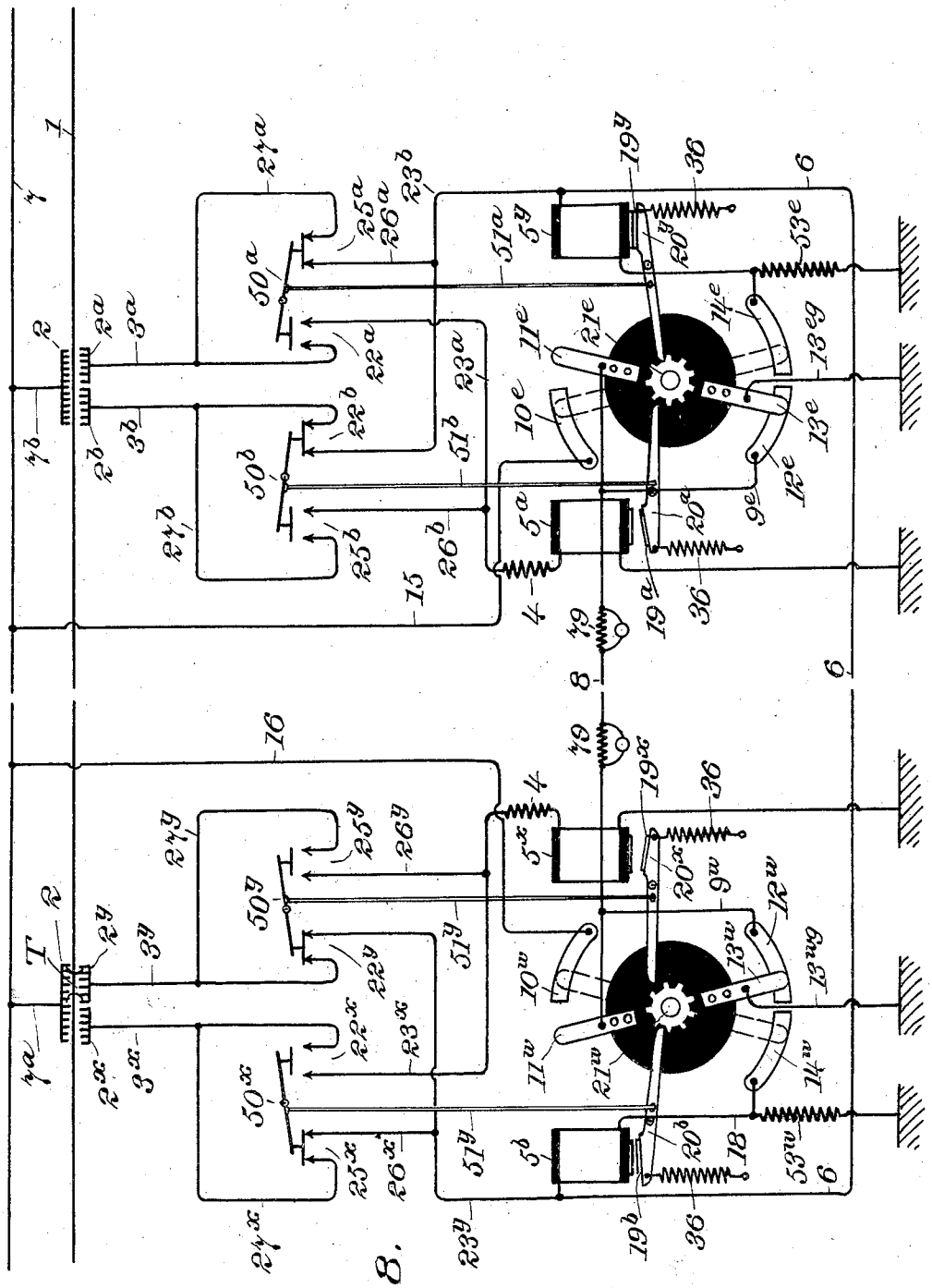

Fig. 8.

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No. 789,239. Patented May 9, 1905.

UNITED STATES PATENT OFFICE.

HOWELL W. SOUDER, OF TAMAQUA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO W. D. ZEHNER, OF LANSFORD, PENNSYLVANIA.

ELECTRIC SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 789,239, dated May 9, 1905.

Application filed May 26, 1904. Serial No. 209,987.

To all whom it may concern:

Be it known that I, HOWELL W. SOUDER, a citizen of the United States of America, and a resident of Tamaqua, Schuylkill county, State of Pennsylvania, have invented certain new and useful Improvements in Electric Signaling Systems, of which the following is a specification.

My invention relates to the controlling of electric circuits generally, and more specifically consists of an approved apparatus for manipulating the circuits and operating the apparatus in electric signaling systems primarily designed for use in electric trolley-roads operated upon the block system.

My invention finds its most useful application in connection with the system of electric railroad-signals shown in my Patent No. 735,416, dated August 4, 1903, and subsequent modifications thereof. As shown in my before-mentioned patent, it has been customary to secure the distinct and separate action of various portions of the signaling system by cars going in different directions through the agency of a set of frogs and short turnouts inserted in the trolley-wire and acting to throw the trolley-wheel always to the right when looking in the direction in which the car is moving. These frogs and turnouts are, however, a somewhat costly element in this system and have to be installed with the greatest nicety or they interfere with the successful operation of the system, and even when constructed and installed with the utmost care they have heretofore remained and still are the weakest and most vulnerable point of my system. My present invention is designed to do away with the said frogs and turnouts and substitutes for them a sectional contact-making device which may be placed in working proximity to the trolley-wire without otherwise affecting the same, and by means of a peculiar arrangement of circuits I am enabled to make the current derived from the section making initial contact with the trolley-wheel control and determine the character of operation of the current derived from the contact-making device as a whole.

The preferred form of apparatus embodying my invention and certain modifications thereof are illustrated in the accompanying five sheets of drawings, in which—

Figure 1 is a diagrammatic view of the circuits and apparatus for a block of a railroad involved in my improved system. Fig. 2 is a plan view, and Fig. 3 an end elevation, of one form of automatic switch and circuit-breaker embodying the circuits shown diagrammatically in Fig. 1. Fig. 4 is a plan view, and Fig. 5 an end elevation, of another form of automatic switch and circuit-breaker. Fig. 6 is a plan view, and Fig. 7 a side elevation, of another form in which the circuit-controller for signaling-circuits is combined with the automatic switch and circuit-breaker, so that the magnets of the circuit-controller operate the circuit-breakers which control the current supplied to the circuit-controller itself. Fig. 8 is a diagram of circuits and apparatus employed when the mechanism shown in Figs. 6 and 7 is used.

Throughout the drawings like reference characters indicate like parts.

1 is the trolley-wire, and 7 a feed-wire, although, of course, the signaling currents may be derived from the trolley-wire itself.

2 2 represent contact-making devices located one at each end of the block and composed, preferably, of two contact-strips or elements parallel to each other and parallel to the trolley-wire, the element on one side being electrically continuous and connected with the feed-wire 7 by branch, as 7^a or 7^b, and the other element or contact-strip of each device being separated electrically into two sections 2^x, 2^y or 2^a and 2^b, the separation being effected along planes transverse to the line of travel of the trolley-wheel along the trolley-wire, so that said trolley-wheel (not shown) will consecutively engage the sections of each contact-making device. The section 2^x is connected by circuit 3^x with the magnet 5^x of the left-hand circuit-controller of the signaling system, and the section 2^y is connected by the circuit 3^y and wire 6 with the magnet 5^y of the right-hand circuit-controller. In the same way the section 2^a of the right-hand contact-making device is connected by the

circuit 3^a with the magnet 5^a of the right-hand circuit-controller, and the section 2^b is connected by circuit 3^b and wire 6 with the magnet 5^b of the left-hand circuit-controller, the circuit-controllers being operated in the manner described in my before-mentioned patent, with the same effect upon the signaling-circuits, which need not here be further described.

In the circuit 3^x is included a normally closed circuit-breaker 22^x, and also at a point farther from the contact-making device there is included an electromagnet 24^x. In the circuit 3^y is included a normally closed circuit-breaker 22^y and an electromagnet 24^y at a point still farther removed from the contact-making device. The magnet 24^x has for an armature the other end 25^y of the lever which forms the bridging-piece of the circuit-breaker 22^y, and said end 25^y of said lever when attracted by the magnet makes contact with the branch conductor 26^y, which extends out from the section 23^x of the conductor extending from the circuit-breaker 22^x to the magnet 24^x. In the same way the magnet 24^y has for an armature the extension 25^x of the lever which forms the bridge-piece of the circuit-breaker 22^x, and said armature when attracted is brought into contact with the branch 26^x which extends out from the section 23^y of the conductor connecting circuit-breaker 22^y with the magnet 24^y. 27^y is a branch connection from the circuit 3^y to the portion 25^y of the circuit-breaking lever, and 27^x is a similar branch or shunt connection from circuit 3^x to the lever 25^x. The arrangement of automatic switch and circuit-breaker in the circuits 3^a and 3^b is similar to that described in circuits 3^x and 3^y, the numeric notation of corresponding parts being the same.

I will now describe the operation of my invention as illustrated by the foregoing diagram before proceeding to describe the various embodiments of these diagrammatic connections.

As shown in diagram Fig. 1, both of the feed connections 15 and 16 to the signal-circuit 8 are cut out and both ground connections 13^{wg} and 13^{eg} are cut in. If now a trolley-car enters the block from the west or left-hand end, its trolley-wheel will first strike the segment 2^x of the left-hand contact-making device and bridging over the space between the contact strip or comb 2 will allow current to pass from the feed-wire, through the branch 7^a, to the circuit 3^x. This current flows through the closed circuit-breaker 22^x, wire 23^x, magnet 24^x, resistance 4, magnet 5^x to the ground. The effect of this is to attract the armature 25^y and open the circuit-breaker 22^y, thereby killing the rest of the circuit 3^y and 6, and also to attract the armature 19^x on the pawl-lever 20^x of the left-hand circuit-controller, thereby rotating the ratchet-wheel 21^w one tooth toward the right, throwing the circuit-controlling switches 11^w and 13^w out of position shown in full lines into the position shown in dotted lines. This causes the current to flow through feed connection 16, contact 10^w, switch 11^w to the lamp-circuit 8 and down through the connection 9^e, contact 12^e, switch 13^e, ground connection 13^{eg}, thereby causing the lamps 79 79 to glow in the manner described in my previous patent. The circuit 3^y being killed beyond the circuit-breaker 22^y, no current passes to it when the trolley-wheel passes along into contact with the segment 2^y; but the current delivered to said segment 2^y passes through the circuit 3^y as far as the branch connection 27^y, from which it passes through the lever 25^y to the contact 26^y and thence through the previously-energized magnet 24^x down through the magnet 5^x to the ground. Accordingly when the trolley-wheel has left the segment 2^x and is in contact only with the segment 2^y the current passing through the branch connection above described will continue to energize the magnet 24^x and retain the circuits in the described condition until the trolley-wheel has left the contact-making device entirely, when the circuit-breaker 22^y will close normally and all the parts will return to their initial position, excepting, of course, ratchet-wheel 21^w. When the car goes out of the block, the trolley-wheel first strikes the section 2^b, sending current through the circuit 3^b, closed circuit-breaker 22^b, wire 23^b, magnet 24^b, wire 6, magnet 5^b, wire 18, contact 14^w, switch 13^w, ground connection 13^{wg}. This causes the magnet 24^b to attract the lever 25^a, opening the circuit-breaker 22^a and killing the circuit 3^a beyond said circuit-breaker. It also energizes the magnet 5^b, causes it to attract the armature 19^b on the pawl 20^b of the left-hand circuit-breaker, which engages the ratchet-wheel 21^w and revolves it one tooth toward the left, throwing the switches 11^w and 13^w back into the position shown in full lines, thereby cutting out the feed connection 16 and putting out the signal-lamps 79 79. The movement of the lever 25^a has also caused it to make contact with the branch 26^a, and when the trolley-wheel passes on to the segment 2^a current flowing through the circuit 3^a and the branch 27^a to the circuit-breaker lever 25^a is delivered through the contact 26^a and wire 23^b to the already-energized magnet 24^b to hold the circuits in the condition already described until the trolley-wheel has completely left the right-hand contact device. A car entering the block from the right-hand or east end will first make contact with the section 2^a and send the current through the circuit 3^a, circuit-breaker 22^a, magnet 24^a, and magnet 5^a to the ground. The energizing of the magnet 24^a will attract the lever 25^b, so as to open the circuit-breaker 22^b and establish connection from the section 2^b through the branch 27^b, lever 25^b, contact

26^b, and wire 23^a to magnet 24^a, setting the right-hand signal-circuit controller so as to supply current to lamps 79 79. In the same way upon leaving the block contact with section 2^y will produce similar results and effect a resetting of the right-hand circuit-controller and the extinguishment of the lamps lighted by the car on entering the block.

The action of the circuit-controllers and signal-circuits being the same as are described in my prior patent and the lettering of the parts having been copied therefrom, further description is believed to be unnecessary.

In Figs. 2 and 3 I have shown a form of automatic circuit-breaker and switch embodying the circuits previously described, and illustrated in Fig. 1. The connection to the section 2^x of the contact-making device is at X, and the connection to the section 2^y is at Y. The circuits 3^x and 3^y may then be traced through the apparatus as follows: When no current is passing, the hinged levers 25^x and 25^y are held by gravity in the positions shown, so that the circuit 3^x passes through the circuit-breaker 22^x, along the contact-piece 26^y and wire 23^x, through magnet 24^x, and out to the signal-circuit controller. In the same way the circuit 3^y passes through the circuit-breaker 22^y, along the contact-piece 26^x, through the wire 23^y and magnet 24^y out to the signal-circuit controller. If now the circuit 3^x is energized, the current passing through the magnet 24^x will cause it to attract the circuit-breaker 22^y, which will swing up into a vertical position, breaking the circuit 3^y from connection with the magnet 24^y, but establishing a branch connection from circuit 3^y through the branch or shunt 27^y, through lever 25^y to contact-piece 26^y, and also through magnet 24^x. If circuit 3^y is energized, the reverse action takes place. In Fig. 3 I have not shown the electrical connections. Said figure merely shows the mechanical construction of the circuit-breakers and magnets as mounted on the non-conducting base A.

Figs. 4 and 5 show a slightly-modified construction. In this case the contact-section 2^x is connected with the binding-post X and the contact-section 2^y is connected with the binding-post Y. When no current passes, the circuit 3^x is through the binding-post X, circuit-breaker 22^x, wire 23^x, magnet 24^x, and out to the signal-circuit controller, while the circuit 3^y is through binding-post Y, circuit-breaker 22^y, wire 23^y, magnet 24^y, and out to the signal-circuit controller. If current passes through the circuit 3^x, the magnet 24^x is energized, lifting the circuit-breaker 22^y and depressing the other end of the lever carrying said circuit-breaker, which lever is marked 25^y. This cuts off the circuit 3^y from magnet 24^y, but establishes a branch connection from it through shunt 27^y, lever 25^y, contact 26^y, and wire 23^x to the already-energized magnet 24^x. When circuit 3^y is energized, the reverse operation takes place. Fig. 5 again shows only the mechanical construction of the magnets and circuit-breakers of this form of apparatus as mounted on the non-conducting base A without electrical connections.

Figs. 6 and 7 show my present invention as applied to and combined with the form of signal-circuit controller illustrated in Fig. 4 of my before-mentioned patent, No. 735,416. In this case the magnets of said circuit-controller are utilized to perform the duties also of the hereinbefore-described magnets 24^x 24^y, &c., in shifting the circuit-breakers and switches which control the circuits supplying current to this signal-circuit controller itself. As shown in the drawings, the apparatus is mounted on a non-conducting base 39 and consists of the two magnets 5^b and 5^x, operating the pawl-levers 20^b and 20^x, which are pivoted upon standards 42 42 and normally held in positions of elevation by the springs 36 36. Each of these pawl-levers carries a pawl 32 32, controlled by the plate-springs 34 34 and pivoted to the pawl-levers at 33 33. These pawls act upon opposite sides of the ratchet-wheel 21^w, which is journaled in the standard 40 and by means of the pin 45 swings the circuit-breaking lever 11^w to the right against the tension of the spring 46, this switch-lever 11^w being pivoted at 43 and cooperating on one side with the contact 12^w and on the other side with the contact 10^w, carrying the spring-face 47. The pin 45 swings the switch-lever 11^w through the agency of the short crank-arm 44, with which it engages, and the ratchet-wheel 21^w is held in position after each rotation by the yielding pawl 37, controlled by the spring 38. 52 and 54 are binding-screws to which certain of the signal-circuit wires may be connected. When combining my present invention with this form of circuit-controller, I add a second base A above the circuit-controller, on which is mounted the circuit-breakers and automatic switches, as shown in Figs. 6 and 7. In this case the bridge-piece of the circuit-breaker 22^x and the bridge-piece 25^x of the shunt-circuit closer are carried on a pivoted lever 50^x, which is connected, by means of link or plunger 51^x, with pawl-lever 20^b. 22^y and 25^y are carried by lever 50^y and plunger 51^y. Normally the circuit-breakers are in the position shown in Fig. 7, with both circuits closed and both branches open. When circuit 3^x, for instance, is energized by the trolley-wheel touching sections 2^x of the contact-making device, the current goes through binding-post X, circuit-breaker 22^x, wire 23^x to magnet 5^x, operating the signal-circuit controller and at the same time pulling down lever 50^y, opening the circuit-breaker 22^y and closing the branch circuit-closer 25^y. Accordingly when the trolley-wheel touches the

contact-section 2^y the current goes through circuit 3^y, binding-post Y, branch 27^y, circuit-closer 25^y, contact 26^y, and wire 23^x to the same magnet 5^x. When a car is going in the opposite direction, the reverse operation takes place.

In Fig. 8 I have shown the connections in diagram as they would appear when a car is going out of the west end of the block, as indicated, by the trolley-wheel T engaging section 2^y of the contact device.

It is evident that it is necessary to segregate the functions of the magnets 5^b and 5^y as actuating means for the circuit-controllers from their functions as actuating means for the circuit-breakers 22^x and 22^a, since when a car passes out of the block it must operate the circuit-breaker at the same end, but not the circuit-controller at that end, the circuit-controller at the other end of the block being the one that is to operate and reset the apparatus, cutting out the signal feed connection at the end. I accomplish this by establishing a permanent ground connection for magnet 5^b through a high resistance 53^w and a similar connection from magnet 5^y to the ground through a high resistance 53^e. The plungers 51^y 51^a are not positively connected to levers 50^x and 50^a, but simply permit them to rise into the positions closing the circuit-breakers, as shown in Fig. 8. The parts are so proportioned that half downward strokes of pawl-levers 20^b and 20^y will operate the circuit-breakers, but will not cause the pawl-levers to actuate the ratchet-wheels of the circuit-controllers. This half-stroke can be brought about by a weak current passing through magnets 5^b and 5^y, generating only enough magnetism to partly extend springs 36 36. When the direct ground connection of magnet 5^b is open, as would be the case when a car is coming through the block from the east end, the current which can pass through the high resistance 53^w to the ground will be just sufficent to move pawl-lever 20^b through half a stroke. This will operate circuit-breaker 22^x, as shown in Fig. 8, and thereby send the current from section 2^x of the contact device, as well as that from 2^y, through circuit 3^x, wire 6, to magnet 5^y. Magnet 5^y, having its direct or short-circuited ground connection established, will cause pawl-lever 20^y to make a full stroke, setting back the east circuit-controller into its normal position, as shown in full lines. A car going out of the east end of the block would give pawl-lever 20^y a half-stroke and pawl-lever 20^b a full stroke, and so reverse the above-described operation. Thus each magnet 5^b or 5^y, when fully energized by reason of the full current passing through its short-circuited ground connection, pulls its spring-controlled armature to it, and thereby opens the switch which controls this direct ground connection, thus compelling the next current impulse to pass through the high-resistance permanent ground connection. When partly energized by the current which will pass through the resistance in the permanent ground connection, these magnets only have power to pull their armatures part way up against the resistance of the springs 36 or against the opposition of gravity if such springs be omitted, and the pawls in such case will only move until they engage the teeth of the ratchet-wheel 21^e or 21^w of the respective circuit-controller. The friction or "drag" of the circuit-controller mechanism prevents further movement of the pawl under the weak pull given to the armature by the partly-energized magnet, and thus the armature is stopped at a partial stroke and the controller remains unaffected; but the partial movement given to the armature is sufficient to operate the circuit-breaker, as above described.

The advantages of my invention comprise the simplicity of line-wire construction (all frogs and turn-outs being eliminated) and certainty of action. There is also great economy resulting from the fact that the cheaply-constructed switch apparatus shown on the base A in Figs. 6 and 7 can be substituted for the costly frog and strain-wire construction heretofore necessary.

It is evident, of course, that various changes could be made in the details of construction here illustrated and that the circuits might be variously rearranged so long as there is preserved the underlying idea of two circuits with normally closed circuit-breakers each responsive to the flow of current in the other circuit, whereby whichever circuit gets the current first kills the other circuit and controls the character of the result produced. It is also evident that my invention may be employed for other purposes than the manipulation of signal-circuits and that the principle involved may be applied to a variety of electric installations.

Having therefore described my invention, what I claim as new, and desire to protect by Letters Patent, is—

1. A contact-making device for electric signals comprising a pair of parallel, oppositely-arranged contact elements insulated from each other and one of said elements being divided into insulated sections along a transverse plane, a feed connection for the undivided element, and work connections for each section of the divided element.

2. A contact-making device for electric signals comprising a pair of parallel, oppositely-arranged contact elements insulated from each other and one of said elements being divided into insulated sections along a transverse plane, a feed connection for the undivided element, and work connections for each section of the divided element, combined with an electric trolley-wire which is located between and parallel to the two described contact elements.

3. The combination of two electric circuits,

means for consecutively supplying current thereto, a circuit-breaker in each circuit, and means for opening each circuit energized by the passage of current through the other circuit, a normally open branch from each circuit to the source of supply of the other circuit, and means for automatically closing each of said branches when the other circuit is opened.

4. The combination of two electric circuits, means for consecutively supplying current thereto, a circuit-breaker normally closed in each circuit, and two electromagnets, one included in each circuit and arranged to actuate the circuit-breaker of the other circuit, a normally open branch from each circuit from a point between its electromagnet and source of supply to the source of supply of the other circuit, and means for automatically closing each of said branches when the other circuit is opened.

5. The combination of two electric circuits, a normally open supply connection for each, and a work connection for each, an electromagnet in each circuit and a normally closed circuit-breaker in each circuit between its electromagnet and its supply connection, mechanism such that when either magnet is energized the circuit-breaker of the other circuit will open, and means for consecutively closing the supply connections of the two circuits.

6. The combination of two electric circuits, a normally open supply connection for each, and a work connection for each, an electromagnet in each circuit and a normally closed circuit-breaker in each circuit between its electromagnet and its supply connection, mechanism such that when either magnet is energized the circuit-breaker of the other circuit will open, and means for consecutively closing the supply connections of the two circuits, together with a normally open branch extending from a point in each circuit between its supply connection and its circuit-breaker to the other circuit at a point between its supply connection and its magnet, and means for closing either of said branch connections when the magnet to be fed by it is energized.

7. The combination of an electric trolley-wire, a contact-making device parallel thereto comprising a pair of parallel oppositely-arranged contact elements insulated from each other and one of them divided into insulated sections along a transverse plane, a feed connection for the undivided element, a work-circuit extending from each section of the divided element, and means for opening each circuit energized by current passing through the other circuit.

8. The combination of an electric trolley-wire, a contact-making device parallel thereto comprising a pair of parallel oppositely-arranged contact elements insulated from each other and one of them divided into insulated sections along transverse planes, a feed connection for the undivided element, a work-circuit extending from each section of the divided element, and means for opening each circuit energized by current passing through the other circuit, said means comprising a normally closed circuit-breaker in each circuit, an electromagnet included in each circuit at a point beyond the circuit-breaker, and mechanism which on the energizing of the magnet in either circuit opens the circuit-breaker in the other circuit, a normally open branch from each circuit at a point between its magnet and circuit-breaker to the other circuit at a point between its connection to the contact-making device and its circuit-breaker, and means operated by the magnet of each circuit when energized to close its above-described branch.

9. In an electric signaling system for electric railroads, the combination of a circuit-controller, a contact device extending parallel to the line of the railroad and divided electrically into two sections, a circuit extending from one section adapted when energized to move the circuit-controller in one direction, a circuit extending from the other section adapted when energized to move the circuit-controller in the other direction, a normally closed circuit-breaker in each circuit, and means operated by the energizing of either circuit to open the circuit-breaker in the other circuit.

10. In an electric signaling system for electric railroads, the combination of a circuit-controller, a contact device extending parallel to the line of the railroad and divided electrically into two sections, a circuit extending from one section adapted when energized to move the circuit-controller in one direction, a circuit extending from the other section adapted when energized to move the circuit-controller in the other direction, a normally closed circuit-breaker in each circuit, and means operated by the energizing of either circuit to open the circuit-breaker in the other circuit and hold same open so long as either section of the contact-making device is energized.

11. In an electric signaling system the combination of an oscillating switch, pawl-and-ratchet mechanism for oscillating said switch, two electromagnets for operating said pawl-and-ratchet mechanism, two independent current-supplying circuits one for each magnet, means for supplying current consecutively to said circuits, a normally closed circuit-breaker in each circuit, and connecting mechanism from the pawl operated by either magnet to the circuit-breaker controlling the circuit of the other magnet.

12. In an electric signaling system the combination of an oscillating switch, pawl-and-ratchet mechanism for oscillating said switch, two electromagnets for operating said pawl-and-ratchet mechanism, two independent current-supplying circuits one for each magnet, means for supplying current consecutively to said circuits, a normally closed circuit-breaker

in each circuit, and connecting mechanism from the pawl operated by either magnet to the circuit-breaker controlling the circuit of the other magnet together with a normally open branch connection from each circuit source of supply to the magnet in the other circuit, and means for closing either branch when the magnet to be fed is energized.

13. The combination of two independent circuits, means for consecutively supplying them with current, a magnet in each circuit, a circuit-breaker in each circuit between the magnet and the source of supply, a normally open branch connection from each source of supply to the magnet in the other circuit, vibrating levers carrying the main circuit-breakers and branch circuit-breakers upon their opposite extremities, and means whereby the magnetism of either magnet will vibrate the lever carrying the main circuit-breaker of the other magnet.

14. In an electric signaling system for a railroad divided into a series of blocks, the combination of a signal-conductor extending along the block, a feed connection and a ground connection at each end of the block, a circuit-controller at each end of the block adapted to simultaneously cut in the feed and cut out the ground connection at its end of the block, each of said circuit-controllers comprising an oscillating switch, pawl-and-ratchet mechanism for oscillating said switch, and two electromagnets for operating said pawl-and-ratchet mechanism, one for setting and one for resetting each controller, two independent current-supplying circuits for the magnets of each circuit-controller, direct ground connections for said resetting-magnets controlled by the oscillating switches, a bridge-wire connecting the resetting-magnets of the two controllers, a high-resistance permanent ground connection for the said resetting-magnets, means for supplying current consecutively to the magnet-circuits operated by a car entering or leaving a block, a normally closed circuit-breaker in each circuit, connecting mechanism from the pawl operated by each magnet of a circuit-controller to the circuit-breaker controlling the circuit of the other magnet of that circuit-controller, and a retracting-spring for each pawl.

15. The combination of an electromagnet, a movable armature therefor, means permitting complete or partial stroke of the armature according to the strength of the magnet pull, a feed connection to one end of said magnet-coils, a permanent ground connection for the other end of the magnet-coils, a resistance in said permanent ground connection, a direct ground connection forming a shunt around said resistance and a switch controlling said direct ground connection operated by a complete stroke of the armature but not by a partial stroke.

16. The combination of an electromagnet, a movable armature therefor, a feed connection to one end of said magnet-coils, a permanent ground connection for the other end of said magnet-coils, a resistance in said permanent ground connection, a direct ground connection forming a shunt around said resistance, a switch controlling said direct ground connection, and connecting mechanism through which the armature acts to open the switch when the magnet is energized by a full current passing through said direct ground connection, but does not operate the switch when the magnet is energized only by current passing through the resistance.

17. The combination of an electromagnet, a movable armature therefor, a pawl operated by the armature, a ratchet-wheel operated by a complete movement of the pawl but not by a partial movement, a feed connection to one end of said magnet-coils, a permanent ground connection to the other end of said coils, a resistance in said ground connection, a direct shunt ground connection around said resistance, and a switch controlling said shunt, which switch is opened by the ratchet-wheel when the pawl makes a complete stroke, the friction of the switch mechanism being sufficient to stop the pawl at a partial stroke upon its engaging the ratchet-teeth when the magnet is energized only by the current which can pass through the resistance.

18. In an electric signaling system for a railroad divided into a series of blocks, the combination of a signal-conductor extending along the block, a feed connection and a ground connection at each end of the block, a circuit-controller at each end of the block adapted to simultaneously cut in the feed and cut out the ground connection at its end of the block, each of said circuit-controllers comprising an oscillating switch, pawl-and-ratchet mechanism oscillating said switch, and two electromagnets for operating said pawl-and-ratchet mechanism, one for setting and one for resetting each controller, direct ground connections for said resetting-magnets controlled by the oscillating switches, a bridge-wire connecting the resetting-magnets of the two controllers, a high-resistance permanent ground connection for each of said resetting-magnets, and additional circuit-controlling mechanism operated by the partial movement of the pawl of the resetting-magnet produced by the magnet when energized by a current which can flow through the high-resistance permanent ground connection.

Signed at Lansford, Pennsylvania, this 28th day of April, 1904.

HOWELL W. SOUDER.

Witnesses:
GEORGE W. KNIES,
E. E. WERNER.