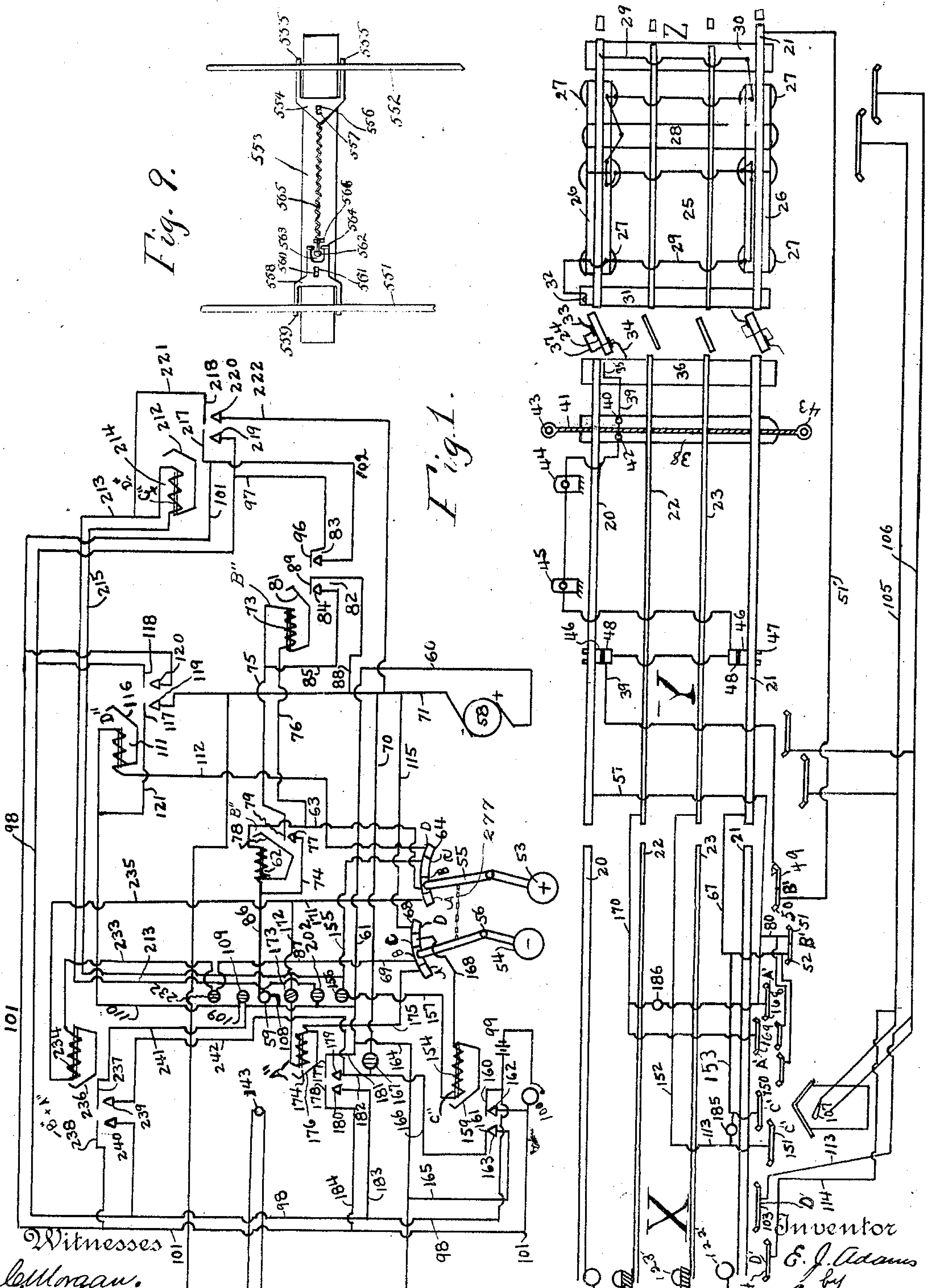
No. 789,702. PATENTED MAY 16, 1905.

E. J. ADAMS.

ELECTRIC SIGNAL SYSTEM.

APPLICATION FILED FEB. 13, 1904.

6 SHEETS—SHEET 1



Witnesses

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6 SHEETS—SHEET 2.

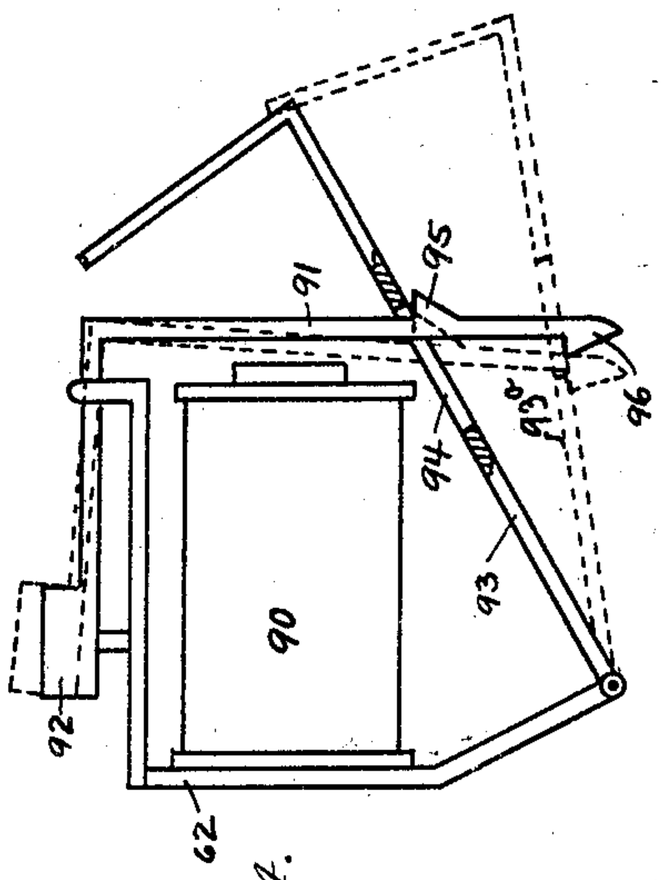

Fig. 4.

Fig. 5.

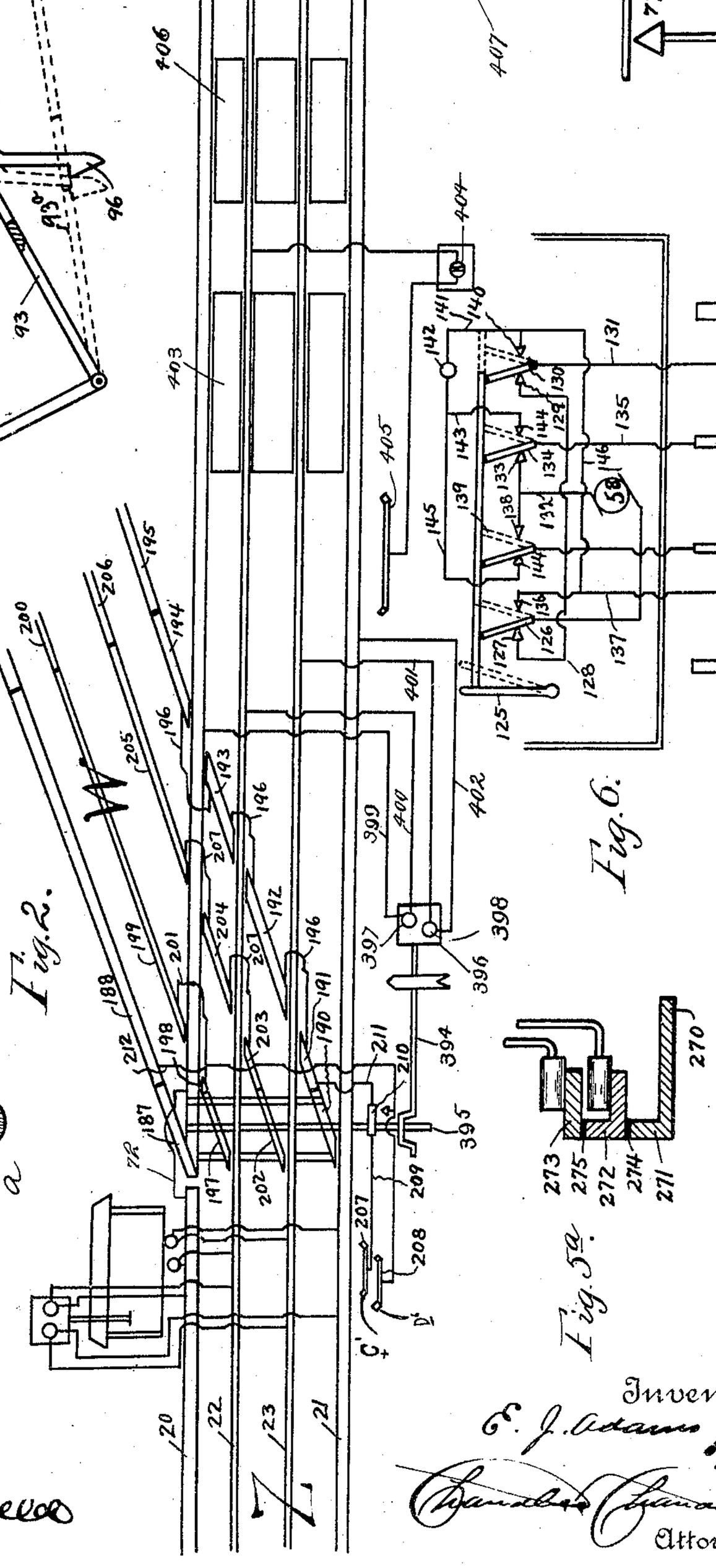

Fig. 2.

Fig. 6.

Fig. 5a.

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6 SHEETS—SHEET 3.

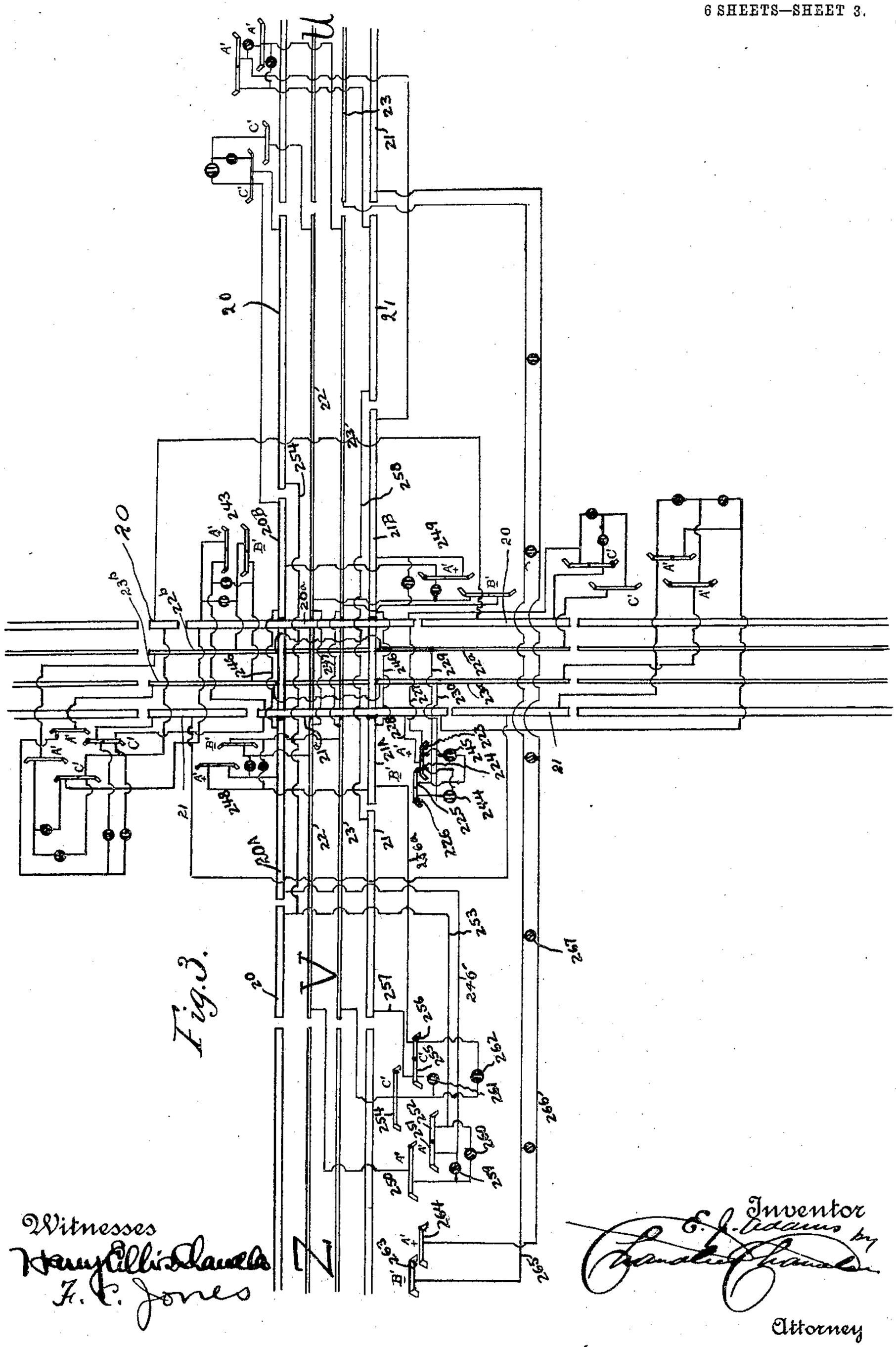

Fig. 3.

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6 SHEETS—SHEET 4.

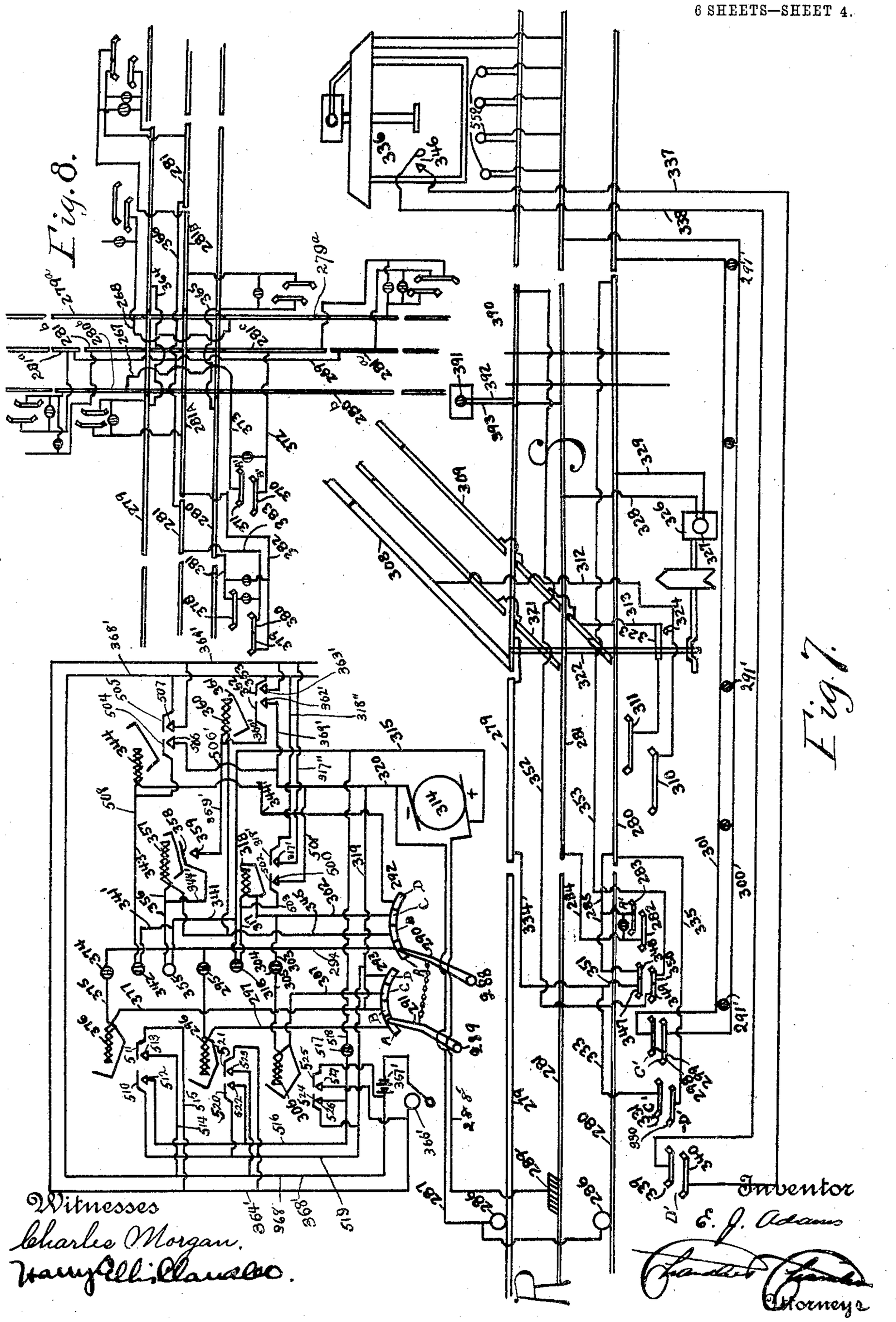

Fig. 8.

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6 SHEETS—SHEET 5.

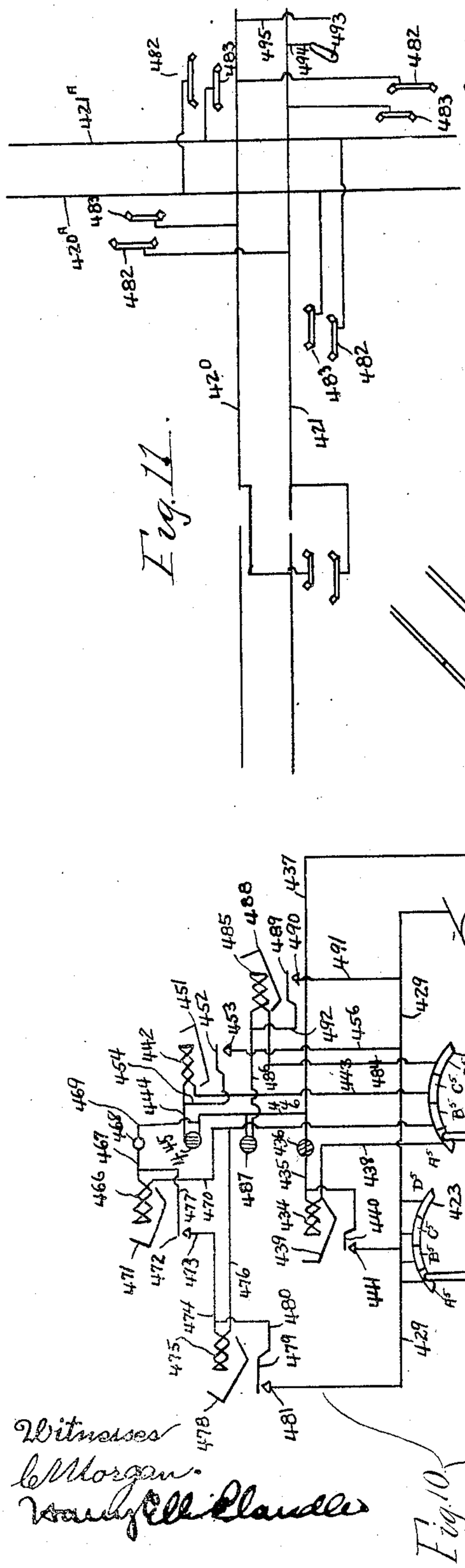

Fig. 11.

Fig. 10.

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6 SHEETS—SHEET 6.

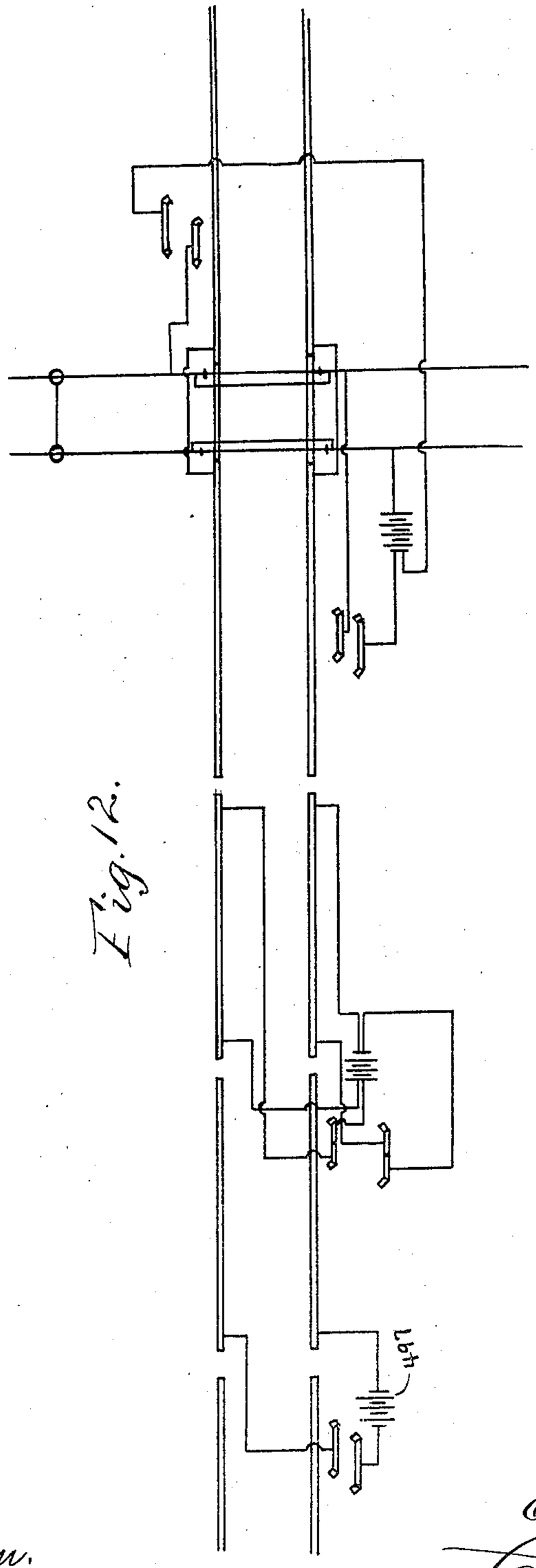

Fig. 12.

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No. 789,702. Patented May 16, 1905.

UNITED STATES PATENT OFFICE.

EDWIN JOHNSON ADAMS, OF WACO, TEXAS.

ELECTRIC SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 789,702, dated May 16, 1905.

Application filed February 13, 1904. Serial No. 193,450.

To all whom it may concern:

Be it known that I, EDWIN JOHNSON ADAMS, a citizen of the United States, residing at Waco, in the county of McLennan, State of Texas, have invented certain new and useful Improvements in Electric Signal Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to electrically-operated signal systems for railways; and it has for its object to provide an arrangement wherein various signals may be sent to a moving or standing train through the medium of a single pair of brushes or trolleys in connection with the track-rails and supplemental conductor-rails and contacting brushes or trolleys or by omitting one or both of the conductor-rails, the intermittent contact-pieces for the first-named brushes or trolleys being so arranged that said brushes or trolleys will be shifted automatically to operate switches which will bring into circuit with a suitable source of electricity the proper signal-circuits on the train to correspond to the actuating contact-pieces. In the present signal system there is arranged at the side of the trackway a pair of contacts corresponding to each signal or group of signals to be transmitted to the engine. There is on the engine a pair of switch-plates divided into segments, and each switch-plate is traversed by a pivoted switch-arm having a trolley at its lower end. To the different segments of the two switch-plates are connected local circuits that are to be energized to give the different signals. The pairs of contact-plates at the side of the trackway are at different elevations, so that when the trolleys engage a pair of contacts they will be swung pivotally and then will travel across the tops of the contacts. This swinging movement of the trolleys shifts the contact-arms over the switch-plates, and when the trolleys reach the central raised horizontal portions of the contact-plates the contact-arms are upon those parts of the switch-plates which are in the local circuit that is to be energized to give the signal corresponding to those contact-plates. In the present system some of the local circuits are connected to corresponding segments of the switch-plates, while their local circuits are not so connected, as will be understood from the following description.

In the drawings forming a portion of this specification, in which like characters of reference indicate similar parts in the several views, Figure 1 is a diagram showing a portion of a track provided with two supplemental conductor-rails and wired to send to a moving train signals indicating the presence of a train in a block ahead and whether the train is approaching or receding; the presence of a train in the next block; the presence of a land-slide on the track; the fact that a drawbridge is open; the fact that the rails have spread; the fact that the track is washed out; the fact that a bridge is damaged or gone; the fact that a track-rail is broken or misplaced, and also to receive manual signals from a station. Fig. 1 also shows the local circuits on the engine for coöperation with said wiring, as also with the wiring shown in Figs. 2 and 3. Fig. 2 is a diagram showing an additional portion of the track and its supplemental conductor-rails, with a portion of a switch or siding and two wagon-road crossings, together with a station, and illustrating the wiring for indicating to the moving train an open switch or the presence of a train on the switch in position to obstruct the main trackway and cause what is known as a "swipe-end" collision; also, the wiring for illuminating the signal-lamps at a station, as also lamps for lighting the platform, for illuminating the lamps in the switch-stand, for illuminating for a short space of time a lamp at a wagon-road crossing, and for illuminating lamps at a wagon-road crossing during the whole time that the train occupies the block. Fig. 3 is a view illustrating the wiring at a railroad-crossing and also to indicate the presence of a train more than one block ahead. Fig. 4 is an elevation showing the annunciator employed in the first step of testing the rails and indicated at B″ of the engine diagram in Fig. 1. Fig. 5 is a perspective view showing a pair of contact-plates with the trolleys in engagement therewith. Fig. 5ª is a vertical section taken transversely through Fig. 5 and

showing the trolleys in elevation. Fig. 6 is a supplemental diagram showing the switch for throwing first one engine-wheel and a brush and then the other engine-wheel and a brush into circuit with the dynamo and their corresponding track and conductor rails. Fig. 7 is a view showing in diagram the local circuits on the engine and the wiring of a portion of a track when the invention is embodied in a system including in its circuits the track-rails and a single supplemental conductor-rail. Fig. 8 is a diagram showing the wiring at a railroad-crossing in the system illustrated in Fig. 7. Fig. 9 is a top plan view of a second form of apparatus for indicating spread rails. Fig. 10 is a diagram similar to Figs. 1 and 7 and showing the invention applied to a system wherein no supplemental conductor-rail is employed. Fig. 11 is a diagram showing a railway-crossing in the system illustrated in Fig. 10. Fig. 12 is a diagram showing the wiring of the track when the source of electricity is located in some stationary position instead of on the engine of the train.

Referring now to the drawings, and more particularly to Fig. 1 thereof, which illustrates what may be termed the "four-rail system," in that it involves the two track-rails and two supplemental conductor-rails, the track-rails are illustrated at 20 and 21 and the conductor-rails at 22 and 23. At the left hand of Fig. 1 is shown a portion of one block of the railway and at the right hand is shown a second block. The second block includes a drawbridge 24 and a fixed bridge 25, the latter including sills 26, that are supported upon posts or piers 27, the sills being connected by ties 28. A wire 29 is connected to the rail 20 just beyond the bridge 25 and is attached or anchored to a tie 30, from which the wire is taken under tension to the sill 26 at one side of the bridge, then to the adjacent post 27, then across the bridge to the opposite post, then to the sill at that side of the bridge, then is attached to the ties between that post and the next post, where it is again attached to the sill at both sides of the abutting ends of the sections of the sill. The wire is then taken to the post below the abutting ends of the sill-sections, then across the bridge to the opposite post, then to one sill-section at that side, then to the other sill-section, then to the next post, then to the opposite post, then to the sill at that side, and, finally, to a tie 31 beyond the end of the bridge, where it is connected to a contact point or piece 32. The drawbridge 24 carries two contact-fingers 33 and 34, which when the bridge is closed engage the contacts 32 and 35, of which the latter is mounted on a tie 36 on an abutment of the bridge. When the draw is open, the circuit between the contact-points 32 and 35 is broken, it being noted that the fingers 33 and 34 are connected by a wire 37.

With the wiring shown on the bridge 25, if any part of the bridge is dangerously displaced the wire 29 will be broken. At 38 is shown a tie which is equipped to indicate when the track is washed out or slid at this point. A wire 39 leads from the contact 35 to an insulator 40 on the tie 38, then is attached to a cable 41, and then an insulator 42 at the opposite side of the cable and mounted on the tie. The cable is attached at its ends to stakes 43, driven into the ground. If the tie is displaced, the wire is broken between the insulators 40 and 42.

To break the wire 39 when a land-slide occurs, said wire is taken from the insulator 42 to the posts 44 and 45, between which it is stretched at the side of the track where a land-slide is liable to occur. The land-slide striking this wire will break it.

To break the wire 39 when the rails spread, a pair of metal plates 46 are employed, having fingers 47, which are engaged against the outer faces of the track-rails, the plates passing under the rails and having at their inner ends the blocks 48, which are insulated from the main portions of the plates. The wire 39 is passed from the post 45 to one of the blocks 48 and then is passed under tension across the track to the opposite block 48, so that when the rails spread the wire between the blocks will be broken by reason of the plates being separated. From the block 48 the wire 39 passes to one section 49 of a contact-plate, the other section, 50, of which plate is connected by a wire 51 to the far end of the rail 21 upon the bridge 25. The contact-plate, which includes the sections 49 and 50, is shown at B′ and is one of a pair of contact-plates which includes the second plate B′, comprising sections 51 and 52. The letters B′ are applied to these contact-plates for the reason that when the trolley-wheels 53 and 54 are upon the plates B′ the pivoted switch-arms 55 and 56, which carry these trolleys, respectively, are in contact at their opposite ends with the segments B of the two arc-shaped switch-plates shown in Fig. 1 to bring into circuit with the contact-plates B′ the annunciators B″. The section 51 of one contact-plate B′ is connected by wire 57 with the rail 20 of the block containing the bridge, it being noted that both contacts B′ are in advance of said block, so that said block is tested before the train enters it.

On the engine is located a dynamo 58, the positive terminal of which is connected through lamp 59, by means of wires 60, 61, and 108, to an annunciator 62, and thence, by means of wire 63, to the segment B of the arc-shaped switch-plate 64. From the segment B the current passes through arm 55 and trolley-wheel 53 to the section 50 of the right-hand contact-plate B′. Assuming that the train is traveling to the right, the trolleys 53 and 54 will of course first engage the sections 50 and 52 and then will pass to the sections 49 and 51,

these sections being insulated from each other, as shown. From the trolley 53 the current passes through section 50 and then through wire 51′ to the far end of the rail 21 of the next block ahead, it being noted that the far end of the wire 21 in the block Y is the far end of the bridge. The current returns down the rail 21 and by way of wire 67 to the section 52 of the left-hand contact-plate B′, from which it passes through the trolley 54 and arm 56 to the segment B of the switch-plate 68 and thence by wires 69, 70, and 71 to the negative side of the dynamo 58. The rail 21 is provided with the usual bonds 72, and if the track-rail 21 is in proper condition for travel the circuit from the dynamo 58 through the annunciator 62 will be closed when the trolleys strike the sections 50 and 52 and the annunciator 62 will be dropped and the lamp 59 lighted to indicate a clear rail. After testing the right-hand rail it is desired to test the left-hand rail and the general track condition—that is, whether or not the block is open for travel with the bridges safe, no land-slides, no washouts, no broken rails, and no spread rails. A second annunciator, 73, is employed and is not brought into circuit with the dynamo 58 until the circuit of the annunciator 62 is broken by passage of the trolleys over the insulation between the sections of the contact-plates. The winding of the annunciator 73 is of less resistance than that of the annunciator 62 and is connected in a shunt around the annunciator 62, said shunt-circuit including the wires 74, 75, and 76. In this shunt-circuit is a make-and-break 77, which is normally open and which is closed when the arm 78 of the annunciator falls onto the spring-finger 79 of the make-and-break and presses it against its coöperating contact. When the make-and-break 77 is thus closed, the current from the dynamo 58 is shunted through the annunciator 73 and it will be connected in circuit between the segments B of the switch-plates 64 and 68, and the current will then be from trolley 53 to contact-plate section 49 and through wire 39, contacts 35 and 34, wire 37, contacts 33 and 32, wire 29 to rail 20, and through wires 57 and 80 to the contact-plate section 51. If this track-circuit is unbroken, the annunciator 73 will drop its arm 81 to close the make-and-breaks 82 and 83. The make-and-break 82 has its contact-point 84 connected by wire 85, wire 75, make-and-break 77, wire 74, wire 86, lamp 59, wire 108, and wires 61 and 60 with the positive pole of the dynamo, while the negative pole is connected by wires 71 and 88 with the finger 89 of the make-and-break 84, so that so long as the arm 81 is in dropped position the lamp 59 will be lighted to call the attention of the engineer to the annunciator 73, and if the lamp 59 continues to burn for any considerable length of time he knows that both track-rails are in safe condition for travel, although the track may be occupied by another train, which will be signaled in a manner to be hereinafter explained.

In order that the shunt-circuit of the annunciator 73 will not be closed when the trolleys are on the sections 50 and 52 of the contact-plates, a peculiar annunciator is employed. (Shown in Fig. 4 of the drawings.) This annunciator includes the usual coil 90, mounted in a suitable frame in which is pivoted the angular latch 91, having a vertical portion, which forms an armature for the coil and which is held normally away from the pole of the coil by the counterweight 92. A portion of the frame of the annunciator extends below the coil 90, and pivoted thereto is a drop-arm 93, having an opening 94 therethrough, through which is passed the lower end of the angular latch 91. The latch 91 has lugs 95 and 96 upon its front and rear faces, respectively, and the counterweight 92 holds the latch normally in such position that the arm 93 will rest upon the lug 95 and be held at the upper limit of its movement. When the annunciator is energized, the latch 91 is swung with its lug 95 out of engagement with the arm 93 and with the lug 96 into position for engagement by the arm 93ª, as indicated in dotted lines, and the arm is thus dropped from the lug 95 to the lug 96. When the circuit of the annunciator 62 is broken, as when the trolleys are passing from one to the other of the sections of the contact-plates, the counterweight 92 swings the latch 91 back to its full-line position and the arm 93 drops onto the finger 79 and presses it against the coöperating contact of the make-and-break 77.

At the same time that the arm 81 closes the make-and-break 84 it also closes the make-and-break 83, the spring-finger 96 of which is connected by wire 97 with wire 98, which leads to a local battery 99, the opposite terminal of which is connected with an electric bell 100, from which leads the wire 101, which is connected with the coöperating contact of the finger 96 through the medium of the wire 102, thus causing the bell 100 to ring. The lamp and bell will be energized until first the annunciator 62 and then the annunciator 73 is thrown up.

In order that a signal may be sent to the engine to indicate some general danger that is not to be sent automatically, such as a stop-order from a station agent, a pair of contact-plates 103 and 104 are used, and a pair of these plates may be arranged at intervals in a block or however else may be determined. The plates 103 and 104 are connected in multiple with wires 105 and 106 at the side of the track, and the wires are connected with a switch 107, which when closed serves to close the track-circuits between the plates 103 and 104 of each pair. When the trolleys strike a pair of plates 103 and 104, which are marked with the letters D′ on the drawings, the con-

tact-arms 55 and 56 are swung to the segments D of the switch-plates. The circuit is then from dynamo 58 through wires 60, 61, and 108 to lamp 109, and thence through wire 110 to annunciator 111, (marked also D″,) and thence through wire 112 to segment D of switch-plate 64, then through contact-arm 55 and trolley to plate 103, then through wire 113 to wire 106, switch 107, wire 105, wire 114, plate 104, trolley 54, arm 56, segment D of switch 68, and wires 115 and 71 to dynamo. When the annunciator 111 is energized, its arm 116 is dropped onto the contact-fingers 117 and 118 and presses them onto the contact-points 119 and 120, and the trolleys passing off of the plates 103 and 104 the local circuit of the dynamo is by way of wires 60, 61, and 108 to the lamp 109, thence by way of wires 110 and 121 to the finger 117, to contact-point 119, and by way of wire 71 to the dynamo, thus maintaining the illumination of the lamp 109 until the arm 116 is raised. The finger 118 and point 120 are bridged across the wires 98 and 101, which are the wires of the bell 100 and battery 99, the object of the bell in each instance being to call the attention of the engineer to the light and the annunciator.

In Fig. 6 of the drawings is shown the circuit of the dynamo 58, by means of which the terminals thereof are connected first with one wheel 122 and the adjacent brush 123, and then the wheel 124 and its adjacent brush 125′, depending upon the direction of movement of the train—that is, whether it is going frontward or backward. In the present system the wheel and brush at the left-hand side of the train are in circuit with the dynamo on the train, while the right-hand wheel and brush are idle or out of circuit. Looking at Fig. 6 of the drawings, if the train is coming toward you the switch-lever 125 is in the position shown in full line, so that the circuit of the dynamo will be to arm 126, point 127, wire 128, switch-point 129, arm 130, and wire 131 to wheel 124, while the opposite side of the dynamo will be connected by wire 132 to switch-point 133, arm 134, and wire 135 to the brush 125′. When the lever 125 is shifted to the opposite position, the circuit of the dynamo is from the positive pole to the arm 126, point 136, to wheel 122 by way of wire 137, while the negative pole of the dynamo is connected by wire 132 through point 138 and arm 139 with the brush 123. If another engine equipped in the same manner is approaching while the engine in Fig. 6 is receding, the wheel 124 and brush 125′ of the approaching engine will energize the rail 21 and contact-rail 23, with which the wheel 124 and brush 125′ shown are in contact, and current will be taken up on the wheel 124 of the receding train and will pass through wire 131, arm 130 in its dotted-line position, point 140, wire 141, lamp 142, wire 143, point 144, and wire 135 to brush 125 and contact-rail 23 in Fig. 1. The lamp 142 will thus be illumined.

Referring to Fig. 1 of the drawings, it will be noted that there is a wheel 122′ running upon the rail 21 and which is connected with the positive terminal of the dynamo 58 and that there is a brush 123′, which is connected with the negative terminal of the dynamo 58, the brush 123′ running upon the contact-wire 23. Now supposing the engine, whose equipment is represented in Fig. 6, enters the block X from the block Y, the brush 123 is upon the contact-wire 23 and the wheel 122 is upon the rail 21. The approaching engine then receives energy from the dynamo 58 on the engine at the left of block X, the circuit being from the dynamo 58 in Fig. 1 to the wheel 122′, rail 21, wheel 122, wire 137, wire 146, wire 141, lamp 142, wire 145, point 144, arm 139, and with its full-line position and brush 123 to contact-wire 23 and brush 123′ to the connected dynamo 58.

Considering now that a train is traveling to the right in Fig. 1, the switch 125 in Fig. 6 will be in its dotted-line position and the wheel 122 and brush 123 will be in circuit with the dynamo 58 to supply current to the rails 20 and 22, respectively, while the wheel 124 and the brush 125′ will be in circuit with the lamp 142 to conduct current thereto from the rails 21 and 23 if the latter be energized from the wheel 122 and brush 123 of an approaching train in the same block.

At the side of the left-hand block in Fig. 1, which is marked X, is arranged a pair of contact-plates 150 and 151, of which the latter is connected by wire 152 with the rail 23 in block Y, while the contact-plate 150 is connected by wires 153 and 67 with the rail 21 in block Y. If then there be an engine in block Y moving to the left, the rails 21 and 23 will be energized from the dynamo on that engine, for the reason that, as hereinbefore stated, the left-hand wheel and brush, considering from the standpoint of direction of movement of the engine, is always in circuit with the dynamo on the engine. The contact-plates 150 and 151 are so located that the trolleys 53 and 54, respectively, of the engine in block X will engage them, and when the trolleys are in position upon the plates the contact-arms 55 and 56 will be on the segments C of the switch-plates 64 and 68 owing to the elevation of the plates 150 and 151. The plates 150 and 151 are marked with the letters C′ to indicate that when the trolleys are on these plates the contact-arms will be on the segments C, and likewise to trace the circuit more readily or to locate more readily the corresponding annunciator 154 said annunciator is marked C″. Throughout the system the letters on the contact-plates indicate the letters of the corresponding segments of the switch-plates and the letters of the corresponding annunciators.

The circuit between the energized rails 21 and 23, which are charged from the dynamo of the approaching engine in block Y, is from rail 21 by wires 67 and 153 to plate 150, thence to trolley 53, arm 55, segment C of switch-plate 64, wire 155, lamp 156, wire 157, annunciator 154, (marked C″,) wire 168, segment C of switch-plate 68, arm 56, trolley 54, plate 151, and wire 152 to rail 23. When the annunciator 154 is energized, its arm 159 drops onto the contact-fingers 160 and 161 and moves them into contact with the points 162 and 163, closing the circuit of the battery 99 through the bell 100 and closing also the circuit of the motor 58 through the lamp 167, the circuit being from the motor through wires 60, 61, 164, and 165 to point 163, and thence through finger 161, wire 166, lamp 167, and wires 70 and 71 to the dynamo.

If the engine in the block Y is traveling to the right—that is, is traveling away from the engine in the block X—then the engine in the block Y will energize the rails 20 and 22 of block Y from its dynamo through its wheel 122 and brush 123. (Illustrated in Fig. 6.) A pair of contact-plates 168 and 169 are arranged at the side of the block X and are connected with the rails 20 and 22 by the wires 57 and 170, respectively. The plates 168 and 169 are so located that when the trolleys run on them the contact-arms 55 and 56 will engage the segments A of the switch-plates, it being understood that after the trolleys are swung rearwardly and upwardly by engagement with contact-plates they return to their normal positions by gravity or may be positively returned in any suitable manner. When the trolleys engage the plates 168 and 169, the circuit is then from rail 20 through wire 57 to contact 168, and thence through trolley 53, arm 55, segment A of switch 64, wires 171 172, lamp 173, to annunciator 174, (marked A″,) and thence by wire 175 to segment A of switch 68, contact-arm 56, trolley 54, contact-plate 169, and wire 170 to rail 22. When the annunciator 174 is energized, it drops its arm 176 upon the contact-fingers 177 and 178 and presses them against 179 and 180, resulting in closing the circuit of the dynamo through the lamp 167 by way of wires 60, 61, and 181 to finger 177, to point 179 by wire 182, to lamp 167, and thence by wire 70 and 71 to the dynamo. The engagement of finger 178 with point 180 closes the circuit of battery 99 through the bell 100 by way of the wire 98 and wire 183 to point 180, to finger 178, and thence through wires 184 and 101 to bell, and thence to battery, thus sounding the bell and lighting the lamp to call the attention of the engineer to the annunciator. As a further signal when there is an engine approaching in the block ahead a lamp 185 is in circuit between wires 152 and 153 and is thus in multiple with the annunciator 154 when the latter is energized. The lamp 185 gives a track-signal to the engine in block X before it reaches the plates 150 and 151. A lamp 186 is likewise connected between wires 57 and 170 to indicate to the approaching engine that the plates 168 and 169 are alive.

Taking now Fig. 2 in connection with Fig. 1, there is shown a continuation of the block Z, in which is located a switch or siding W including two track-rails and two intermediate conductor-rails. The track-rails are shown in sections, of which the sections of one rail are indicated by the numerals 187, 188, and 189, while the sections of the other track-rail are indicated by the numerals 190, 191, 192, 193, 194, and 195. The sections 187, 188, and 189 are insulated from each other. The sections 191, 192, 193, and 194 are connected by wires 196, while such sections are insulated from the sections 190 and 195. One of the conductor-rails comprises sections 197, 198, 199, and 200, the sections 198 and 199 being connected by wire 201, while said sections are insulated from the sections 197 and 200. The other conductor-rail comprises sections 202, 203, 204, 205, and 206, of which the sections 203, 204, and 205 are connected by wires 207 and are insulated from the other sections. The sections of the rails that are connected by wires are those sections that lie at opposite sides of the rails of the main track. At the side of the main track in advance of the switch are contact-plates 207 and 208, which are connected, respectively, with the sections 191 and 188 of the track-rails of the switch W, so that if a car is standing upon any portion of the section 188 an electric circuit will be completed from the plate 207 to the plate 208 through wire 209, finger 210, wire 211, and thence to the several sections 191, 192, and 193, and 194 of a switch track-rail, thence through the wheels and axle of a car to the opposite rail-section 188, and thence by wire 212 to the plate 208. The plates 207 and 208 are at such elevations that when the trolleys are thereon the contact-arms 55 and 56 will be swung to the segment C of switch-plate 64 and the segment D of switch-plate 68, as indicated by the letters C′ and D′ on the contact-plate. It will be noted that the trolley 53 is marked with a positive sign and the trolley 54 with a negative sign, and the letters on the contact-plates 207 and 208 are similarly marked to show which trolley engages each plate. With the contact-arms on the segments C and D of switch-plates 64 and 68 the circuit of the dynamo 58 is wires 60, 61, and 108 to lamp 202, thence by wire 213 to annunciator 214, marked plus C″ minus D″,) thence by wire 215 and wire 155 to segment C of switch 64, thence through arm 55 and trolley 53 to plate 207 and over the track-circuit above described to the plate 208, to trolley 54, arm 56, segment D of switch 68, and wires 115 and 71 to the dynamo. When this circuit is closed, the arm 212 is dropped onto fingers

217 and 218 and presses them against the point 219 and 220. When the finger and point 217 and 219 are in contact, the wires 98 and 101 are bridged to close the circuit of the battery 99 through the bell 100, and when the finger 218 is on the point 220 the circuit of the dynamo is closed through lamp 202 by way of wires 60 61 108, lamp 202, wire 213, wire 221, finger 218, point 220, and wires 222 and 71 to the dynamo. The bell will continue to ring and the lamp will continue to be lighted until the annunciator-arm is thrown back.

Referring now to Fig. 3 of the drawings, there is shown a railroad-crossing and a system of wiring which will show to the approaching engine not only that an engine is approaching or receding beyond the crossing in the next block, but will also show whether an engine is approaching from either direction on the cross-track. The wiring shown will also indicate approximately the proximity of the other engine to the railroad-crossing. In the block V and to the left of the crossing-track is a pair of contacts, one of which comprises two insulated sections 223 and 224 and the other of which comprises two insulated sections 225 and 226. The crossing railroad comprises two track-rails including sections 20^a and 21^a, which are continuous from side to side of the main trackway, including rails 20 and 21, and to the rail 20^a is connected the plate-section 223 by means of wire 227, while the section 224 is connected by wire 228 with the rail 21^a. The plate-section 225 is connected by wire 229 with the conductor-rail section 22^a at the right of the main trackway, while the plate-section 226 is connected by wire 230 to the conductor-rail section 23^a at the same side of the main track. At the opposite side of the main-track rail are conductor-rail sections 22^b and 23^b, which are wired to the sections 22^a and 23^a, respectively, as shown. Supposing then an engine enters the block V from the block Z and there be an engine on the rail-sections 20^a and 21^a at the crossing traveling to the left of the train on the main track, it will be remembered that the left-hand track-rail and left-hand conductor-rail are always in circuit with the dynamo of the engine, and the rail-sections 21^a will be energized from the wheel of the crossing engine, and the sections 23^a and 23^b will be energized from the brush of the crossing engine, and the contact-plate sections 226 and 224 will be in circuit with the dynamo on the crossing engine. When the trolleys 53 and 54 strike the contact-plates and run onto the sections 224 and 226, the contact-arms 55 and 56 are swung to the segments A and B, respectively, of the switch-plates 64 and 68, respectively, the circuit from the section 226 being through the trolley 54, arm 56, segment B, wire 69, wire 87, lamp 232, wire 233, annunciator 234, (marked minus B″ plus A″,) and thence by wire 235 to segment A of switch-plate 64, contact-arm 55, and trolley 53 to contact-plate section 224. At this time the arm 236 of annunciator 234 is dropped onto the fingers 237 and 238 and forces them against the points 239 and 240. The engagement of finger 238 with point 240 bridges the wires 98 and 101 in the bell-circuit, so that the bell 100 is operated until the arm 236 is raised. The contact of finger 237 with point 239 closes the circuit of the dynamo 58 through the lamp 167, the circuit from the dynamo being wires 60, 61, 108, and 241 to finger 237, to point 239, wire 242, wire 182 to lamp 167, and wires 70 and 71 to dynamo. It will be noted that in each case where the annunciator is operated by a current from the dynamo of the opposite engine the lamp 167 is lighted when the annunciator drops—as, for instance, at the railway-crossing signal, the rear-end-collision signal, and the head-end-collision signal, the rear-end-collision signal meaning a receding train ahead, while the head-end-collision signal means an approaching train ahead. The other annunciators serve to close the circuit of the dynamo on the train through the lamps that are initially lighted by the said dynamo, it being the object to maintain these lamps lighted until the engineer shall have noted the signal received and shall have returned annunciator-arms to their original or normal positions. If the train on the crossing-track is moving in the opposite direction to that above described, the contact-plate sections 223 and 225 receive currents from the rail-sections 20^a and 22^a, respectively, and the annunciator 234 is not operated until the trolley-wheels pass to these second sections of the contact-plates. This arrangement provides for a signal to the engine on the main track from an engine passing in either direction over a crossing, it being noted that the active rail-sections of the crossing are continued a suitable distance at each side of the main trackway, so as to insure the signal being sent in time for the train on the main track to stop. The opposite side of the main track is provided with contact-plates (indicated generally at 243) and which are connected in like manner with the same cross-rail sections as the plates just described. To indicate to a train on the main track approaching the crossing that the crossing is occupied, so that the signal will be received before the train on the main track reaches the contact-plates, a lamp 244 is bridged between the sections 224 and 226, while a lamp 245 is bridged between the sections 223 and 225, these lamps being of high resistance, so as not to prevent the operation of the annunciator and engine-lamp at the proper time.

The track-rail 21 of the block V comprises a plurality of sections of which the sections 21^A and 21^B are directly adjacent to the rails of the crossing-track and are wired together, as illustrated. The rail 20 of the block V in-

cludes also sections of which the sections 20^A and 20^B are at opposite sides and directly adjacent to the crossing-track and are wired together, as illustrated at 246. The conductor-rail 22 is in two sections, one at each side of the crossing-track, as is also the conductor-rail 23, the sections of each of these conductor-rails being wired together at 247. Between the track-rails of the crossing-track are dummy rail-sections, as illustrated, which serve to support the rollers or brushes in their transit over the crossing-rails.

The crossing-track rails are provided with a pair of contact-plates and lamps at each side of the main trackway and at opposite sides of the crossing-track, as indicated at 248 and 249, the connections of these contact-plates with the lamps and the rail-sections of the main track being the same as the connections of the first-named plates with the rail-sections of the crossing-track.

The signals that are received from the contact-plates just described and which are the crossing-signals are given only when both engines are in close proximity to the crossing, so that there would be danger of a collision if they were to continue. The short rail-sections connected with these plates form only a small part of a block, and in order that the system may be complete provision must be made for sending head-end signals and rear-end signals to the engine in the block Z when an engine is on either the short mutually-connected rail-sections directly adjacent to the crossing or whether it is on the sections at the ends of the block V. For this purpose a pair of rear-end contact-plates and a pair of head-end contact-plates are provided at the end of the block Z adjacent to the block containing the switch and at the same end of the block U and of the corresponding blocks of the crossing-track, so the description of the plates of the block Z will suffice for all. For the rear-end signal there are employed a plate 250 and a plate comprising sections 251 and 252, the plate 250 being connected with the conductor-rail 22, the section 251 being connected with the rail-section 20^A through wire 246′, while the contact-plate section 252 is connected by wire 253 with the end sections of rail 20 in block V, these end sections being mutually connected by wire 254. The trolley-wheels 53 and 54 run onto these contact-plates, the wheel 54 taking the plate 250, while the wheel 53 takes first the section 251 and then the section 252, swinging the contact-arms to the segments A of the switch-plates, as indicated by the letters A′ on the contact-plates. The section 252 receives current from the end sections of the rail 20 if there be a receding engine on either of said sections. The contact-plate section 251 receives current from rail-sections 20^A and 20^B if there be a receding engine on such sections, and the annunciator 174 in Fig. 1 (marked A″) will therefore be dropped if there is a receding engine in any part of the block V. To indicate in the same way an approaching engine in the block V, that is to give a head-end signal, a contact-plate 254 for engagement by trolley 54 is connected with the conductor-rail 23, while a second contact-plate for engagement by the trolley 53 consists of sections 255 and 256, which are connected, respectively, with the end sections of rail 21 by wire 257 and through wire 258, connecting said lower sections, and with the sections 21^A and 21^B, respectively. These last-named contact-plates are marked with the letters C′, indicating that the contact-arms will be swung to the segments C of the switch-plates, so that the annunciator 154 at C″ will be operated, as hereinbefore described. The operating-current passes from conductor-rail 23 to contact-plate 254, while the sections 255 and 256 of the second contact-plate receive their current from the end sections of the rail 21 or the sections 21^A and 21^B, depending upon the positions of the approaching train in the block V. When a receding train is at either end of the block V, the lamp 259, which is in multiple between plate 250 and section 251, is illuminated, and when such train is adjacent to the crossing the lamp 260 in multiple between plate 250 and section 252 is illuminated. Similar lamps 261 and 262 are connected in multiple, respectively, between plate 254 and section 255 and plate 254 and section 256.

In order that an approaching train in the second block ahead or block U may be indicated to the engine in block Z, contact-plates 263 and 264 are disposed for engagement by the trolleys 54 and 53, respectively, these plates shifting the contact-arms to the segments B and A of plates 68 and 64, respectively, the same as for the crossing-signal. In multiple between the wires 265 and 266, which connect said plates with the rails 23 and 21, respectively, are lamps 267, so that if the engineer gets a signal and sees the lamp at the side of the track when the annunciator 234 drops he knows that it is a head-end signal from the second block ahead. This same arrangement will be indicated between the blocks X and Z in Fig. 1 and all the blocks throughout the system.

Referring to Figs. 5 and 5^a of the drawings, there is illustrated a pair of contact-plates such as are used in the present system. A base 270 is provided, having an upturned flange 271, upon which is supported a flange-plate 272, having supported thereon a plate 273, these several plates being insulated, as indicated at 274 and 275. These plates are of suitable metal, and the ends 276 of each plate are curved downwardly and are insulated from the remainder of the plate, so that as the engine moves along the track its trolleys will strike these curved ends and the trolleys will be guided upwardly onto the main body

portions of the plates and in this upward movement will shift the contact-arms to the proper segments of the switch-plates. The trolley 54 always takes the higher plate and the trolley 53 the lower plate. The trolley 53 runs onto the lower plate before the trolley 54 reaches the upper plate, and connecting the switch-arms is a chain 277, so that when the arm 55 moves by contact of its trolley with the lower plate the arm 56 will be similarly moved to raise its trolley 54 into position to engage the inclined end of the upper plate. The lower plate 272 is illustrated as divided into two sections by the insulation 278.

Referring now to Figs. 7 and 8 of the drawings, there is shown a railway comprising track-rails 279 and 280 and a conductor-rail 281 in the place of two conductor-rails, as in the former system. In this system there are employed two contact-plates 282 and 283, (marked A′,) of which the plate 282 is connected by wire 284 with the conductor-rail 281, while the plate 283 is connected by wire 285 with the track-rail 280. In this system, as shown in Fig. 7, the negative pole of the dynamo is connected to both driving-wheels 286 by wire 287, while the positive pole of the dynamo is connected by wire 288′ with the brush 289′, that rubs the rail 281, it being understood that a trolley may be substituted for the brush, if desired. When a train is therefore on the block S, both track-rails and the conductor-rail will be energized, and when the trolleys 288 and 289 strike the contact-plates the contact-arms 290 and 291 will be shifted to the segments A of the switch-plates 292 and 293, so that the current will be from plate 283 through trolley 288, arm 290, segment A, wire 294, lamp 295, annunciator 296, wire 297, to segment A, arm 291, trolley 289, and plate 282, and thence to the conductor-rail 281 over the wire 284. This indicates the presence of a train in a block ahead, but does not indicate whether it is approaching or receding. The train in the second block ahead energizes the contact-plates 298 and 299 through the wires 300 and 301, that are connected with the conductor and track rails, respectively. These contact-plates are marked C′ and indicate that the trolleys when they run thereon shift the contact-arms to the segments C of the switch-plates, so that current is conducted to these segments, and the circuit is from segment C of switch 292 through wires 302 and 303 to lamp 304, wire 305, annunciator 306, and wire 307 to segment C of switch 293. The rails 308 and 309 of a switch are connected, respectively, with contact-plates 310 and 311 by wires 312 and 313, and these plates are so located that when the trolleys run onto them the arm 290 will be shifted to its segment C and the arm 291 will be shifted to its segment D; also, lamps 291′ between wires 300 and 301 are illumined. In the prior signals described the circuit was energized from the opposite engine; but in the switch-signal the circuit is energized from the dynamo 314, the circuit being from the positive pole of the dynamo over wire 315, through lamp 316, wire 317, annunciator 318, wire 302, segment C, arm 290, trolley 288, plate 311, wire 313, rail 309, wheels and axle of car, rail 308, wire 312, plate 310, trolley 289, arm 291, segment D, and wires 319 and 320 to the negative terminal of the dynamo. Connected to the switch-rail 309 and the conductor-rail 321 is the switch-rod 322, to which is connected a contact-finger 323 for engagement with the point 324 when the switch is open. The finger 323 is connected between the plate 311 and the wire 313, while the point 324 is connected with the wire 312, so that when the switch is open the circuit between the plates 310 and 311 is closed, with the same results as when the circuit is closed by a car on the switch-rails, as above described. In the box 326 on the switch-stand is a lamp 327, from which lead wires 328 and 329 to the conductor-rail and track-rail 281 and 280, respectively, so that when an engine is in the block S and these rails are energized the lamp will be lighted.

It will be noted that the switch-contacts 310 and 311 are in the block containing the switch, so that other contact-plates 330 and 331 of the same elevation may be employed in the block R ahead of the switch-block to drop the same annunciator 318 to indicate a different condition. These contact-plates 330 and 331 are connected with the track-rails in block S, the first through the medium of wire 335 and the second through the medium of wires 333 and 334, so that when the block S is obstructed, as by a car therein, the circuit between these two plates will be completed through the wheels and axle of such car. The current for this circuit is supplied from the dynamo over the same wiring as for the plates 310 and 311, above described, it being noted that the plates 330 and 331 are marked plus C′ and minus D′. From a station 336 a signal may be sent to a moving train through the wires 337 and 338, which are connected to contact-plates 339 and 340 of such elevation that when engaged by the trolley-wheels will serve to shift the contact-arms to their respective segments D, the circuit then being from the dynamo over wires 315, 341, and 341′, lamp 342, wire 343, annunciator 344, wire 344′ to segment D of switch 292, arm 290, trolley 288, plate 339, wire 338, switch 346, wire 337, plate 340, trolley 289, arm 291, segment D, and wires 319 and 320 to dynamo. One other pair of contact-plates is shown in Fig. 7, one of said plates comprising sections 347 and 348 and the other comprising sections 349 and 350. Section 347 is connected to rail 279 by wires 351 and 334 at one end of S, while the section 348 at that plate is connected to the same end of the rail 280. Section 349

is connected to the far end of rail 279 by wire 352, while section 350 is connected to the far end of rail 280 by wire 353. These contact-plates are so positioned that when the trolleys run over them they will be shifted to the segments B of the switch-plate, and as the contact-plates are each in two insulated sections two electrical impulses will be imparted due to the breaking of the circuit in passing over the gap between the sections. At this time the circuit is from dynamo over wires 315 and 341 to lamp 355, wire 356, annunciator 357, wire 345, segment B of switch-plate 292, thence through arm 290, trolley 288, section 347, wires 351 and 334 to rail 279, wire 352, section 349, trolley 289, arm 291, segment B, wire 319 and 320 to dynamo. When the trolleys pass to sections 348 and 350, the circuit is from plate 348 to rail 280, wire 353 and section 350, the local circuit being the same as just described. The annunciator 357 is constructed as shown in Fig. 4 of the drawings, and the second drop of the arm of the annunciator permits it to rest upon the finger 358 and move it to point 359 to close the circuit of annunciator 360 in a shunt-circuit connected with the wire 356 between the lamp 355 and the annunciator 357. The resistance of the annunciator 360 is less than that of the annunciator 357, so that when this shunt-circuit is closed the annunciator 360 will be positively energized to drop its arm 361 onto the two contact-fingers 362 and 363. When the two contact-fingers 362 and 363 are depressed, they engage the contact-points 362′ and 363′. The point 363′ is connected by wire 364′ with one side of an electric bell 366′, the other side of which is connected with a battery 367′, from which leads a wire 368′ and a contact-finger 363, so that when the annunciator 360 is operated the bell is rung so as to call the attention of the engineer to the lamp 365. The point 362′ is connected by wire 369′ to wire 320 and the negative side of the dynamo 314, while the finger 362 is connected between the contact-point 359 and the annunciator 360, so that when the finger 362 is against the point 362′ the circuit of the dynamo is by wire 315, wire 341 to lamp 355, wire 356, shunt-wire 344′, finger 358, contact 359, wire 359′, shunt-wire 360′, finger 362, contact-point 362′, and wire 320 to dynamo, thus maintaining the illumination of the lamp 355 after the trolleys have left the contact-plates and until the drop of the annunciator 357 is restored. It will be noticed that the positive side of the dynamo is connected direct to all of the lamps, while the circuit-closers operated by the annunciators are connected between the lamps and the negative side of the dynamo, one of such circuit-closers comprising the contact-point 317′ and finger 318′, of which the latter is arranged to be depressed by the drop of the annunciator 318, the contact 317′ being connected by wire 317″ with wire 364′ and thence to bell 366′, while the finger 318′ is connected by wire 318″ with the wire 368′ and thence to the battery 367′. The contact-point 500 is connected by wire 501 with wire 320 and thence to the negative terminal of the dynamo, while the finger 502 is connected by wire 503 to the wire 317 between the annunciator 318 and the lamp 316. When the drop of the annunciator 318 falls on the finger 502, it depresses it against the point 500, so that the circuit between the lamp 316 and the dynamo 314 is maintained, the circuit being from dynamo, wire 315, lamp 316, wire 317, wire 503, finger 502, contact 500, wire 501, wire 320, to dynamo. Beneath the drop of the annunciator 344 are the fingers 504 and 505, which under the weight of the drop are pressed against the points 506 and 507, respectively. The finger 505 is connected to wire 368′, and the point 507 is connected to wire 364′, so that when the finger 505 is depressed the circuit of the battery 367′ is closed through the bell. The finger 504 is connected to wire 508 between the lamp 342 and the annunciator 344, so that when the finger 504 is depressed against the point 506 the circuit will be from dynamo 314, wires 315, 341, and 341′, lamp 342, wire 508, finger 504, point 506, wire 506′, wire 320, to dynamo.

In connection with the annunciator 376 are contact-fingers 510 and 511, which are depressed against the contact-points 512 and 513 when the drop falls upon them. The point 513 is connected by wire 514 with the wire 368′, while finger 511 is connected by wire 515 with the wire 364′ to close the circuit between said wires 364′ and 368′ when the finger 511 is depressed, and thus operate the bell 366′. Point 512 is connected by wire 516 with a lamp 517, which is connected by wire 518 with wire 315 and thence to the positive pole of the dynamo, the finger 510 being connected by wire 519 with the wire 319 and thence through wire 320 to the negative pole of the dynamo, so that when the finger 510 is depressed the lamp 517 is illumined. Fingers 520 and 521 are disposed beneath the drop of the annunciator 296 and have contact-points 522 and 523. Finger 521 and point 523 are connected with wires 364′ and 368′, respectively, to close the circuit of the battery 367′ through the bell 366′, and the finger 520 is connected with wire 519 and the point 522 with the wire 516 to contact the last-named wires and close the circuit of the dynamo through the lamp 517. Fingers 524 and 525 are disposed beneath the drop of the annunciator 306 and have contact-points 526 and 527, respectively. Finger 524 is connected to wire 519, and contact 526 is connected by wire 516 to close the circuit of the dynamo through the lamp 517. Finger 525 is connected to wire 368′, and contact 527 is connected to wire 364′ to close the circuit of the battery 367′ through the bell 366′. Thus

whenever an annunciator is operated the bell is rung, and a lamp is burned until the annunciator is restored.

In Fig. 8 of the drawings is shown the wiring at a railway-crossing where a single conductor-rail is employed. The track-rails 279 and 280 are continuous in the block up to the crossing-rails and are connected across the crossing-rails by wires 364 and 365. The conductor-rail comprises the end sections 281 and the inner sections 281^A and 281^B, which are directly adjacent to the crossing-track. The outer sections 281 are connected by wire 366. The crossing-track rails 279^a and 280^b are continuous in the block up to the main-track rails, where they are connected from one side to the other of the main trackway by wires 267 and 268. The conductor-rail of the cross-track includes end sections 281^a and inner sections 281^b and 281^c, which are directly adjacent to the main track, the end sections 281^a being connected by a wire 269. At the side of the main trackway are contact-plates 370 and 371, of which the former is connected by wire 372 with the conductor-rail section 281^c, while the latter is connected by wire 373 with the rail 280^b. When an engine is upon the rails 280^b and 279^a and over the conductor-rail sections 281^b or 281^c, it sends the current of its dynamo through such rails and the connected wires to the contact-plates 370 and 371, which are so positioned that when the trolleys strike them the arm 290 will move to the segment A and the arm 291 to the segment B, the circuit from the plates being through trolley 288, arm 290, segment A, wire 294, lamp 374, wire 375, annunciator 376, and wire 377 to segment B, arm 291, trolley 289, and contact-plate. To detect the presence of a train or engine moving in either direction on the block at the crossover, two contact-plates are employed, one of which consists of a single section, (shown at 378,) while the other comprises two sections 379 and 380. The plate 378 is connected by wire 381 with the rail 280. The section 379 is connected by wire 382 with conductor-rail section 981^A, and the contact-plate section 380 is connected by wire 383 with the conductor-rail section 281. The two contact-plates are of such elevation that when the trolleys run onto them they are moved to swing the contact-arms to the segments A, so that if an engine is in the block containing the crossing at the ends of such block it will send current by the track-rail 280 and the end sections of the conductor-rail 281 to the plate 378 and the plate-section 380, and when the engine in the preceding block reaches these plates and its trolleys are passed onto them current will pass through the annunciator 296 in the same manner as hereinbefore described. If the train is over the conductor-rail section 281^A or 281^B, then the current will pass to the section 379 instead of 380; but the result at the annunciator 296 will be the same. The same arrangement of contact-plates is provided at each side of both the main trackway and the crossing-trackway, and by dividing the conductor-rails into the short sections directly adjacent to the crossing-track the engine on either track is signaled from the engine on the other track when the latter is directly adjacent to the crossing to indicate such location.

It will be noted that while in the four-rail system the opposing train furnishes the current to give the head-end, rear-end, and crossing signals in the three-rail system the opposing train gives the crossing-signal and the simple train-signal from one block to the first or second block ahead. The other signals are energized by the dynamo on the engine that receives the signal. The annunciators have each a lamp that is lighted when the annunciator is dropped, and there is a bell common to all of the annunciators which is sounded at the same time. Those annunciators that are operated from the dynamos on the engine shunt the current from the dynamo through their lamps when the annunciators are dropped, while the other two annunciators close the circuit of the dynamo through a different lamp.

At 390 in Fig. 7 is shown a wagon-road crossing where there is a danger-lamp 391 the terminals of which are connected to the track-rail and conductor-rail, respectively, by wires 392 and 393, so that so long as an engine is in that block the lamp will be lighted from the engine-dynamo. In Figs. 10 and 11 of the drawings there is shown the present invention embodied in a system in which there are no supplemental rails.

Reverting to Fig. 2 of the drawings, it will be noted that the switch-stand 394, which is rotated when the switch-rod is shifted, carries a lantern-box 396, in which are disposed two electric lamps 397 and 398. The box 396 has two of its opposite sides red and the other two sides clear, which show, respectively, when the switch is opened and closed. The terminals of lamp 397 are connected by wires 399 and 400 with the track and conductor rails 20 and 22, while the terminals of lamp 398 are connected by wires 401 and 402 with the conductor and track rails 23 and 21.

At 403 is shown a wagon-crossing, adjacent to which is a signal-lamp 404, one terminal of which is connected with a contact-plate 405, disposed for engagement by the roller 53, while the other terminal is connected with the return conductor-rail 22, so that while the locomotive is traveling the length of the plate 405 the lamp will be illuminated. The plate 405 may be of any desired length. At 406 is shown a second wagon-crossing, adjacent to which are two lamps 407 and 408. The terminals of lamp 407 are connected to rails 21 and 23, while the terminals of lamp 408 are connected to rails 20 and 22, so that one lamp is illuminated as the train is traveling in one direction, while the other lamp is illuminated

while the train is traveling in the other direction, the illumination continuing until the train has left the block containing the railway-crossing.

Referring now to the Figs. 10 and 11 of the drawings, and more particularly to Fig. 10, there is shown a system wherein no central or supplemental conductor-rails are employed. In this system the track-rails are shown at 420 and 421. The engine in this instance is provided with a dynamo 422, with switch-plates 423 and 424, and with switch-levers 425 and 426, having contact-rollers 427 and 428. All of the segments of the switch-plate 423 are connected with a wire 429, which leads from the negative terminal of the dynamo. In order to detect the presence of a train in the second block ahead, a pair of contact-plates 430 and 431 are provided and are connected with the rails 420 and 421 of said second block ahead by means of wires 433 and 432, respectively. An annunciator 434 is provided on the locomotive, and one terminal thereof is connected by a wire 435 through a lamp 436 and by wire 437 with the positive terminal of the dynamo 422. The other terminal of the annunciator is connected by a wire 438 with the section A^5 of the switch-plate 424. Plates 430 and 431 are disposed for engagement by the rollers 428 and 427, respectively, and are of such heights that they will shift the levers 425 and 426, so that they will rest upon the sections A^5 of both switch-plates. The circuit of the dynamo will then be wire 437, lamp 436, wire 435, annunciator 434, wire 438, segment A^5, lever 426, roller 428, plate 430, wire 432, rail 421, wheels and axle of locomotive in the distant block, wire 433, plate 431, roller 427, lever 425, segment A^5, wire 429 to dynamo. The annunciator-drop 439 is then released and falling upon the spring-plate 440 moves it into engagement with the contact-point 441, which latter is connected with wire 429, the spring-plate being connected with wire 435. There is then established a local circuit from the dynamo through wire 437, lamp 436, wire 435, spring-plate 440, contact-point 441, and wire 429 to dynamo. The lamp 436 will thus be illuminated until the annunciator-drop is returned. To indicate the presence of a train in the first block ahead, an annunciator 442 is provided, one terminal of which is connected by wire 443 with segment C^5 of the switch-plate 424. The other terminal of the annunciator is connected by wire 444 through lamp 445 and wires 446 and 437 with the positive terminal of the dynamo 422. Contact-plates 447 and 448 are provided and are connected with the rails 420 and 421, respectively, of the first block ahead by wires 449 and 450. These plates are engaged by the rollers 427 and 428 and serve to shift the contact-levers to the segments C^5 of their respective contact-plates. The circuit from the dynamo is then through wires 437 and 446 to lamp 445, wire 444, annunciator 442, wire 443, segment C^5 of plate 424, lever 426, roller 428, plate 447, wire 449, rail 420, axle and wheels of locomotive, rail 421, wire 450, plate 448, roller 427, lever 425, segment C^5 of plate 423, wire 429 to dynamo. The drop 451 falls on spring-plate 452 and presses against contact-point 453, so that the circuit of the dynamo is shunted from a point between the lamp 445 and the annunciator 442 by means of wire 454, contact-plate 452, point 453, wire 456 to wire 420 and dynamo. The lamp 445 is thus illuminated until the annunciator-drop is returned. Two contact-plates 460 and 461 are provided similar to the other contact-plates, excepting that each one is divided into two sections. The rollers 427 and 428 first engage the foremost sections of the two plates and then the rear sections, respectively. The front sections of the plates are connected by wires 462 and 463 with the terminals of the rail 420, while the rear sections are connected by wires 464 and 645 with the terminals of the rail 421. If the terminals of the dynamo are connected with the front sections and the circuit is completed, it will indicate that the rail 420 is intact, and if the circuit is completed through the rear sections it will indicate that the rail 421 is intact. To indicate first the complete circuit through the front sections and then through the rear sections, an annunciator 466 is provided one terminal of which is connected by wire 467 to lamp 468 and then by wires 469, 446, and 437 to the positive terminal of the dynamo. The other terminal of the annunciator is connected by wire 470 to the segment B^5 of the switch-plate 424. When the rollers run onto the plates 460 and 461, they shift the levers to the segments B^5. The circuit of the dynamo is then from its positive terminal through wires 437, 446, and 469, lamp 468, wire 467, annunciator 466, wire 470, segment B^5, front end of plate 460, wire 462, rail 420, wire 463, front end of plate 461, roller 427, lever 425, segment B^5 of plate 423, and wire 429 to dynamo. The annunciator-drop 471 then falls onto the spring-finger 472 and presses it against contact-point 473, which is connected by wire 474 with annunciator 475, the opposite terminal of which is connected by wire 476 with the wire 470 and thence to segment B^5 of plate 424, the spring-finger 472 being connected by wire 477 with the wire 467. When the rollers move upon the second or rear sections of the plates 460 and 461, the current of the dynamo is then shunted around the annunciator 466 and through the annunciator 475, which is of lower resistance. The drop 478 then falls on spring-finger 479, which is connected by wire 480 with the wire 474, and said spring-finger is pressed against the contact-point 481, to which the wire 429 is connected. The current from the dynamo is

then shunted around the annunciator 475, the circuit being then from the dynamo through wire 437, 446, and 469 to lamp 468, wire 467, wire 477, spring-finger 472, point 473, wire 474, wire 480, spring-finger 479, point 481, and wire 429 to dynamo. If both the annunciators drop, the track-rails are intact. This test may also show a land-slide by arranging the wires 463 and 465 at opposite sides of the track on posts similar to the arrangement shown between the posts 44 and 45 in Fig. 1; also, either wire may include in its circuit a spread-rail-testing apparatus. The test, as described, will show the danger also if there be a washout or an open draw-bridge. It will be noted that this series of contact-plates is arranged at the right-hand side near the end of each block as the train leaves the block, so that before entering the next block the several signals may be given. It is sometimes desired to test the rails in a block after the train has entered the block, as when approaching known dangerous places, and for this purpose the wheels of the train must be insulated from the main-track rails the same as if the train were in a different block. For this purpose sections 481′ in opposite portions of the track-rails are insulated from the remaining portions of the track-rails, and the ends of the main rails at opposite sides of these insulated sections are bonded, as shown at 482. When the locomotive is on these independent or disconnected rail-sections, the tests of the rails may be made in the same manner as if the locomotive were in the preceding block, as above described.

In Fig. 11 of the drawings there is shown the wiring at a railway-crossing where rails 420^{A} and 421^{A} cross the rails 420 and 421. A pair of contact-plates 482 and 483 are placed at the right of the main trackway at each side of the crossing-track as the locomotive approaches the crossing, and other contact-plates 482 and 483 are arranged to the right of the crossing-track at each side of the main track as the locomotive approaches the main track. The contact-plates adjacent to the main track are connected with the rails of the crossing-track, and the contact-plates adjacent to the crossing-track are connected to the rails of the main track, so that if a train is on one track it will close the circuit between the contact-plates adjacent to the other track, said circuit being closed through the wheels and axles of the cars. When the rollers strike the contact-plates 482 and 483, the switch-levers are shifted onto the segments D^{5} of their respective switch-plates, said segment of the plate 424 being connected by a wire 484 with one terminal of an annunciator 485, while the opposite terminal is connected by a wire 486, a lamp 487, and thence by wires 446 and 437 with the positive terminal of the dynamo 422, the negative terminal of the dynamo being connected, by means of the wire 429, with the segment D^{5} of the plate 423. When the rollers are on the contact-plates 482 and 483, they will complete the circuit of the dynamo 422 through the annunciator 485 and lamp 487 over the circuit just traced if a train is in the block of the crossing railroad through which the main tracks pass. When the annunciator is energized, its drop 488 falls upon the spring-plate 489 and moves it against the contact 490, which is connected by wire 491 with the wire 429, which leads to the negative terminal of the dynamo. There is then established a local circuit to the dynamo through wires 437 and 446 to the lamp 487, wire 486, wire 492, plate 489, contact 490, and wires 491 and 429 to dynamo. The wire 492 connects the contact-plate 489 with the wire 486 between the lamp and the annunciator. The lamp will then be illuminated until the annunciator-drop is thrown up. If it is desired to send a stop-signal to the moving train, as from a station, a switch 493 may be employed and connected, by means of wires 494 and 495, with the track-rails, so that when the switch is closed the rails will be electrically connected. The same signal will then be sent to the locomotive as if a train were in the block.

Under some conditions it may be preferred to energize the track-rails from a stationary source of electricity instead of from a source on the train, and for such a purpose batteries 497 are shown in Fig. 12 of the drawings connected in signal-circuits similar to those shown in Fig. 10 and in Fig. 11.

The same test that determines an open draw-bridge, a disabled bridge, the spread rails, landslides, and washout will give the same indication if there is a broken or misplaced rail, or if the return-rail is broken, or if the circuit is interrupted from any other cause. Furthermore, the wire upon the bridge will comprise at intervals fusible sections, so that in the event of the bridge catching fire the circuit will be broken.

As shown in Fig. 7, lamps 550 may be arranged along the station-platform with their terminals connected to the track-rail and the conductor-rail, respectively, so that when the train reaches the station it will supply the current to the lamps to light them.

In Fig. 9 there is shown an apparatus for closing a circuit when the rails are spread. In this figure, 551 and 552 represent the track-rails mounted upon a tie 553. A plate 554 has fingers 555 engaged beneath the rail 552 to hold the plate thereto, the plate being held to the tie by a spike 556, passed through a slot 557, which permits of movement of the plate with the rail if the latter moves toward the end of the tie. A second plate 558 has its fingers 559 engaged beneath the rail 551 and is secured to the tie by a spike 560, engaged through a slot 561, and which also permits of

movement of the plate longitudinally of the tie. The head 562 of a pin lies within the opening 563 at the inner end of the plate 558 in position to engage the contact-fingers 564 when moved in the direction of the rail 552, and this pin is connected to the plate 554 by the spring 565, so that if either rail moves laterally in the direction of the adjacent end of the tie the head 562 will come in contact with the fingers 564 and close the circuit between the rails. A guide 566 upon the tie holds the headed pin against displacement and consequent accidental engagement with the contact-fingers.

It will be understood that a pair of contact-trolleys may be arranged at each side of the locomotive, one for use when running forward and the other when running backward, and that any suitable means may be used for raising every set out of active position.

In the arrangement shown in Fig. 10 of the drawings the bell and bell-circuit in the cab are the same as that previously described.

It will be noted that when the rails spread the electrical relation of the contact-plates corresponding to the rails is changed—that is, whereas when the rails are in their normal positions the corresponding contact-plates are electrically connected said plates are electrically disconnected when the relative positions of the rails are changed, and hence the means for breaking the electric circuit between the contact-plates may be termed "means for changing the electrical relation of said plates." The structure shown in Fig. 9 of the drawings serves to close a circuit when the rails spread, and hence any means which either closes a circuit between the contact-plates or breaks a circuit previously used between the contact-plates has means for altering the electrical relation of the contact-plates.

What is claimed is—

1. In a railway signal system, the combination with pairs of contact-plates disposed adjacent to the railway and having different elevations corresponding to the different signals to be transmitted, of a series of electrically-operated indicating mechanisms mounted upon a vehicle adapted to traverse the railway, a source of electricity, a pair of contact devices disposed for contact with the pairs of contact-plates successively and movable to different degrees by the plates of different heights, and means operable by movement of said contact devices for bringing the different indicating mechanisms and the source of electricity into circuit with the corresponding contact-plates.

2. In a railway signal system, the combination with pairs of contact-plates disposed adjacent to the railway and having different elevations corresponding to the different signals to be transmitted, of a series of electrically-operated indicating mechanisms mounted upon a vehicle adapted to traverse the railway and each including a lamp, a source of electricity, a pair of contact devices disposed for contact with the pairs of contact-plates successively and movable to different degrees by the plates of different heights, means operable by movement of said contact devices for bringing the different indicating mechanisms and the source of electricity into circuit with the corresponding contact-plates, and means actuated by operation of each indicating mechanism for closing the circuit of the source of electricity through the corresponding lamp.

3. In a railway signal system, the combination with a pair of contact-plates disposed adjacent to the railway and each including corresponding insulated sections, one corresponding pair of sections of the contact-plates being electrically connected with the ends of one rail of a block and the other corresponding sections of the contact-plates being connected with the ends of the other rail of the block, of a vehicle disposed to traverse the railway and having contact devices disposed to engage the corresponding sections of the contact-plates simultaneously, a source of electricity on the vehicle, an electrically-operated signal device for each of the rails, means for connecting one of said signal devices and the source of electricity in circuit with the contact devices when the latter engage the first corresponding sections of the contact-plates and means actuated by operation of the last-named signal device for connecting the second signal device and the source of electricity in circuit with said contact devices when the latter engage the second sections of the contact-plates.

4. In a railway signal system, the combination with pairs of contact-plates disposed adjacent to the railway, of a series of electrically-operated indicating mechanisms mounted upon a vehicle adapted to traverse the railway, a source of electricity, a pair of contact devices disposed for contact with the pairs of contact-plates successively, means for bringing the contact devices into electrical connection with the indicating mechanisms corresponding to the contact-plates in action, and a lamp connected between the contact-plates of each pair.

5. In a railway signal system, the combination with contact-plates, an electrically-operated indicating mechanism mounted upon a vehicle adapted to traverse the railway, means in electrical connection with the indicating mechanism for engaging the contact-plates, a source of electricity in circuit with said means, and a lamp connected between the contact-plates.

6. In a railway signal system, the combination with a trackway including track-rails and a conductor-rail, of a vehicle disposed upon the track-rails, means carried by the vehicle

for engaging the conductor-rail, a source of electricity carried by the vehicle and connected between said contact devices and a wheel of the vehicle, and a signal-lamp at the side of the trackway in circuit between the conductor-rail and a track-rail.

7. In a railway signal system, the combination with track-rails and a conductor-rail, of a contact-plate, a signal-lamp connected between the contact-plate and the conductor-rail, a source of electricity, and a vehicle adapted to traverse the track-rails and having means for connecting said source of electricity in circuit between the conductor-rail and the contact-plate.

8. In a railway signal system, the combination with a trackway including track-rails and conductor-rails, of a vehicle having supporting-wheels engaging the track-rails and contact devices engaging the conductor-rails, contact-plates at each side of the trackway electrically connected with corresponding sections of the track-rails, an electrical indicating mechanism upon the vehicle, a source of electricity and means for connecting said source of electricity and indicating mechanism between either track-rail and the corresponding conductor-rail corresponding to the direction of movement of the vehicle.

9. In a railway signal system, the combination with track-rails, of a vehicle disposed to run thereon, an electrically-operated indicating mechanism upon the vehicle, contact-plates at the side of the track, a source of electricity, means for connecting said contact-plates in circuit with the source of electricity and the indicating mechanism, and means in circuit between said contact-plates and connected with the track-rails for changing the electrical relation of said contact-plates when the relative positions of the track-sections are changed.

10. In a railway signal system, the combination with track-rails, of contact-plates arranged at one side thereof, a wire supported at the side of the track-rails and extending longitudinally thereof and adapted to be broken when struck, said wire being in circuit between contact-plates, a vehicle disposed to travel upon the track-rails, means carried by the vehicle for engaging the contact-plates, and means upon the vehicle in circuit with said engaging means for indicating a rupture of the circuit between the contact-plates.

11. In a railway signal system, the combination with intersecting trackways, of contact-plates at the side of eack trackway at each side of the intersecting trackway, each set of contact-plates being in circuit between the rails of the crossing trackway, a vehicle adapted to run upon the track-rails, contacting devices carried by the vehicle for engagement with each set of contact-plates individually, an electrical indicating mechanism upon the vehicle in circuit with said contact devices and a source of electricity for said circuit.

12 In an electric signal system, the combination with a trackway including track-rails and conductor-rails, of a vehicle adapted to traverse the track-rails, contact devices carried by the vehicle and disposed to engage the conductor-rails, a source of electricity upon the vehicle, a lamp upon the vehicle, and a switch constructed and arranged to connect the source of electricity and the lamp interchangeably in circuit between said contact devices and a wheel of the vehicle.

13. In a railway signal system, the combination with track-rails divided into blocks, each opposite rail-section insulated from the remaining portions of the block and said remaining portion of each rail of each block having its sections electrically connected, contact-plates electrically connected respectively with said electrically-connected sections of the rails, and a vehicle adapted to traverse the rails, an electrically-operating indicating apparatus carried by the vehicle and contact devices carried by the vehicle in circuit with said indicating apparatus and disposed to engage the contact-plates respectively when the vehicle is upon said insulated rail-sections.

14. In a railway signal system, the combination with a trackway, including main rails and switch-rails, the latter including sections adjacent to the main rails that are insulated from the remaining sections, contact-plates adjacent to the main track at a point distant from the switch and connected in circuit respectively with said insulated sections of the switch-rails, and a vehicle adapted to traverse the rails, said vehicle having an electrically-operating indicating mechanism and connected contact devices disposed to engage the contact-plates and connect said indicating mechanism in circuit between said insulated sections of the switch-rails.

15. In a signal system, an indicating mechanism comprising a signal, a source of electricity, an electrically-operated circuit-closer connected between the signal and source of electricity for energization by the latter, contact devices in circuit with the source of electricity and the lamp, a shunt around the contact devices and the circuit-closer and including the signal and the source of electricity and arranged to be closed by the circuit-closer and a local circuit arranged to be closed by said circuit-closer, the local circuit including a supplemental signal and a source of electricity.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN JOHNSON ADAMS.

Witnesses:

B. R. MASON,

JNO. C. LEES.