

A. J. ALLARD.

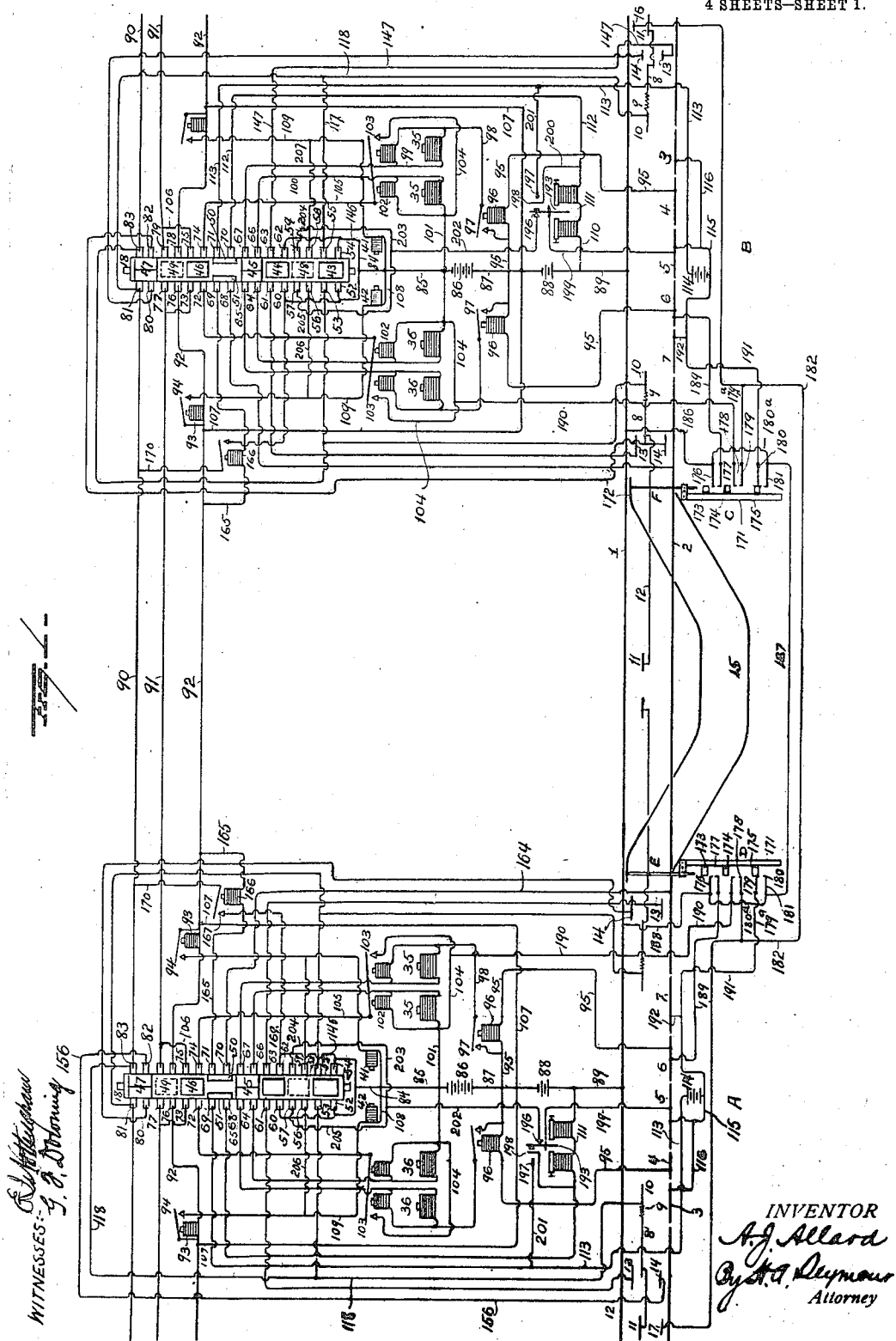
ELECTRIC TRAIN SIGNALING AND CONTROLLING SYSTEM.

APPLICATION FILED DEC. 4, 1911. RENEWED FEB. 3, 1913.

1,060,405.

Patented Apr. 29, 1913.

4 SHEETS-SHEET 1.



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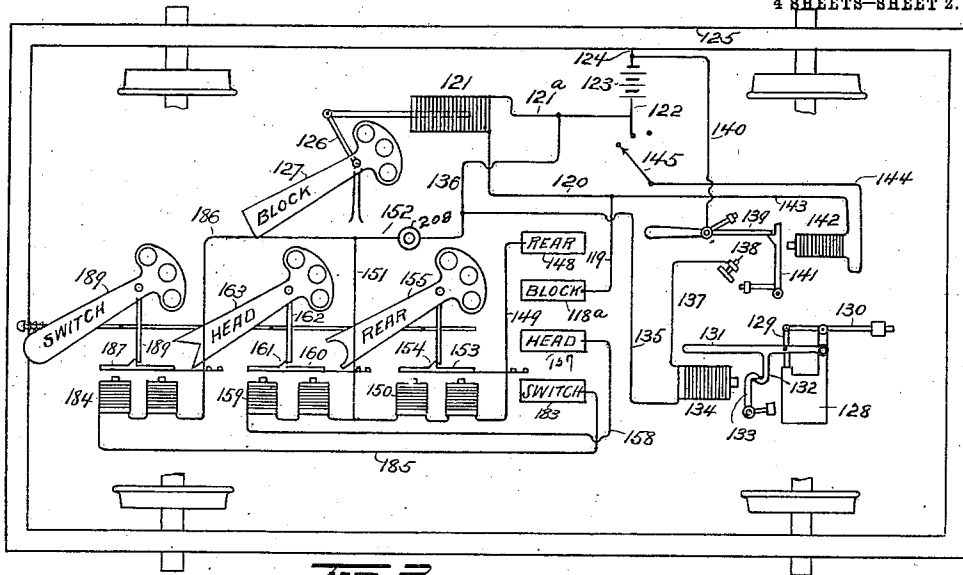


Fig. 2.

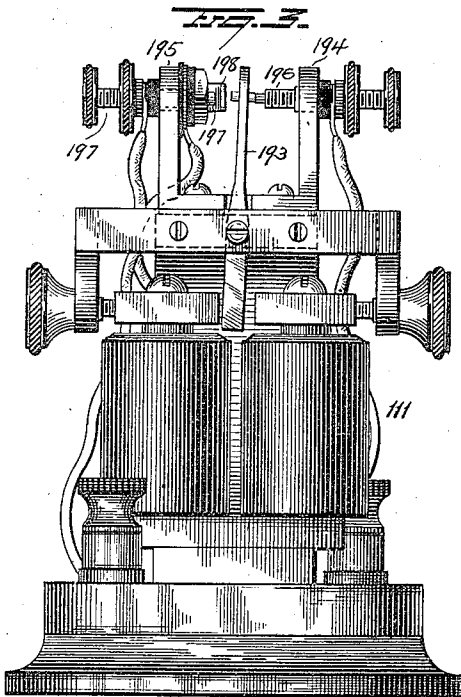


Fig. 3.

WITNESSES
E. Nottingham
G. F. Downing.

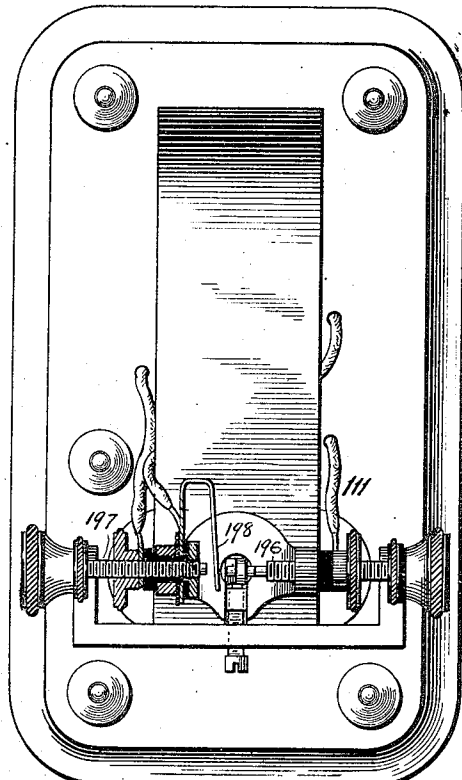


Fig. 4.

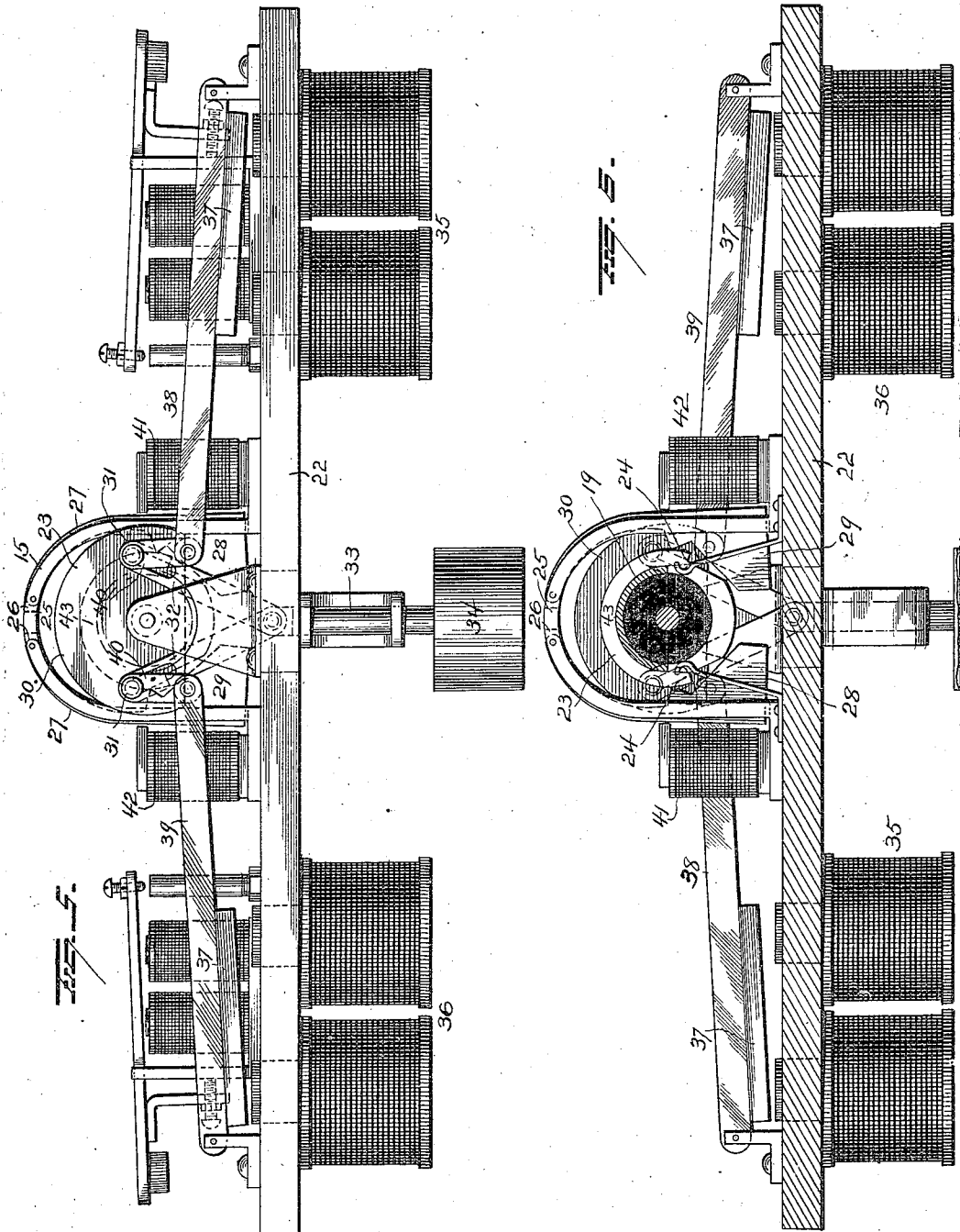
INVENTOR
A. J. Allard
By S. A. Seymour
Attorney

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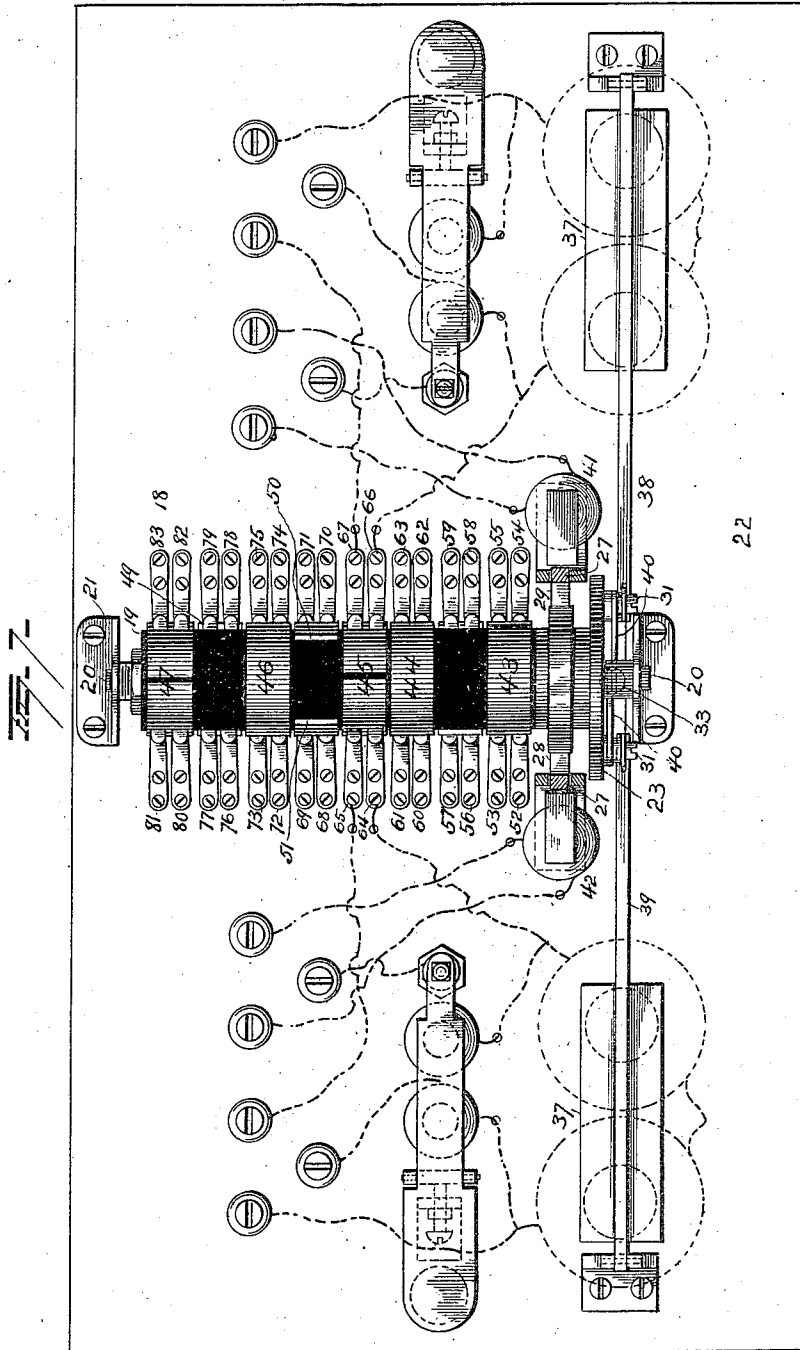
INVENTOR
A. J. Allard
By H. A. Deymour
Attorney

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WITNESSES
E. D. Nottingham
G. J. Downing

INVENTOR
A. J. Allard
By H. A. Seymour
Attorney

UNITED STATES PATENT OFFICE.

ANDREW J. ALLARD, OF RICHMOND, VIRGINIA, ASSIGNOR OF ONE-THIRD TO T. F. GREEN AND ONE-THIRD TO D. R. CREECY, JR., OF RICHMOND, VIRGINIA.

ELECTRIC TRAIN SIGNALING AND CONTROLLING SYSTEM.

1,060,405.

Specification of Letters Patent.

Patented Apr. 29, 1913.

Application filed December 4, 1911, Serial No. 663,743. Renewed February 3, 1913. Serial No. 746,037.

To all whom it may concern:

Be it known that I, ANDREW J. ALLARD, a citizen of the United States, residing at Richmond, in the county of Henrico and State of Virginia, have invented certain new and useful Improvements in Electric Train Signaling and Controlling 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 improvements in electric train-signaling and controlling systems, and more particularly to such as are intended to display signals in the cabs of locomotives, and to cause automatically, the stopping of a train if the signals be ignored.

One object of my present invention is to provide means which shall operate to protect trains from head-on and tail-end collisions, by displaying signals in the locomotive which shall indicate to the engineer the approach of another train running in the same or in the opposite direction,—and also by automatically stopping the train if the signals be not properly observed.

A further object is to provide, in an electric block signaling system, switch signaling means for use with switches at the ends of a siding and which shall cooperate with the block-signaling appliances.

With these and other objects in view, the invention consists in certain novel features of construction and combinations of parts as hereinafter set forth and pointed out in the claims.

In the accompanying drawings, Figure 1 is a diagrammatical view illustrating my improvements; Fig. 2 is a diagrammatical view showing the circuits and devices on the locomotive; Figs. 3 and 4 are views of the relay; Fig. 5 is a front elevation showing the circuit-controlling instrument; Fig. 6 is a sectional view of said instrument, and Fig. 7 is a plan view of the same.

In Fig. 1 of the drawing, I have shown one complete block containing a siding, and the adjacent ends of two other blocks,—the instrumentalities of the several blocks being made to overlap at the intersections of the blocks, as will hereinafter appear.

In the cab of the locomotive, various signals and train-controlling means are located, and the operations of the same are

controlled by the automatic manipulation of the various circuits under varying conditions as a train proceeds along the line of railway.

1, 2, represent the rails of a railway track. The rail 1 is continuous, while the rail 2, is divided, at the intersection of the blocks, into several insulated sections 3, 4, 5, 6, 7. Comparatively near, and at respective sides of the juncture of each two blocks, contact rails 8 are centrally located between the rails of the track and these are connected, through the medium of resistance devices 9, with shorter contact rails 10. Located some distance from each long rail 8, is a short, centrally located contact rail 11 which is electrically connected with said long rail by means of a suitable conductor 12. Contact rails 13 and 14 are located at respective sides of the center of the track near one end of each central contact rail, and when a siding occurs between the ends of a block, short contact rails 16, 17 are located appreciable distances from the ends of the siding and nearer to the track rails than are the contact rails 13 and 14. The various contact rails are intended for cooperation with contact shoes on a locomotive for the purpose of completing circuits through certain signaling and controlling appliances on the locomotives, and the truck frame of the latter also serves to electrically connect the track rails, all as hereinafter more fully explained. Near the intersection of the blocks of railway, circuit shifting instruments are located. Each of these instruments comprises a drum 19 of insulating material, and the journals 20 of said drum are mounted in brackets 21 secured upon a suitable base 22. To one end of the drum, a notched ring is secured, the notches in said ring forming shoulders 24. A yoke 25 is secured to the platform and extends over the notched ring. This yoke is made with elongated slots 26, in the upper portions of which, the upper ends of curved arms 27 of weighted dogs 28—29 are pivotally supported, the teeth of said dogs being adapted to engage the respective shoulders 24 of the notched ring and lock the drum in the position to which it may be moved. A disk 30 is secured to one end of the drum 19 and to this disk, at diametrically opposite sides of its center depending pins 31 are secured. With these pins, the upper portions of slotted

links 32 are connected and these links are pivotally connected at their lower ends to a pendulous rod 33 depending through an opening in the base 22 and provided at its lower end with a weight 34. It is apparent that the weight 34, connected with the drum as above described, will operate to retain the drum in its normal position to permit said drum to be turned in one direction or the other from its normal position, and to return said drum to its normal position when released. For the purpose of turning or rocking the drum 19, electro-magnets 35—36 are provided. The armatures 37 are carried by pivoted levers 38—39, and the free inner ends of these levers are connected, by means of links 40, with the pins 31 on the disk 30. The weighted dogs 28—29 are so pivotally supported that the teeth of said dogs will press toward the notched ring 23 so that when the drum is turned in one direction or the other, one of these dogs will drop under one of the shoulders 24 of said ring and thus lock the drum in the position to which it has been shifted. The dogs 28—29 will be actuated to release the drum, by means of electro-magnets 41—42,—said magnets being included in circuit and controlled as hereinafter explained.

The drum 19 of the circuit controlling instrument 18 is provided with a plurality of contact plates to coöperate with contact fingers as will now be described. Although the drum is cylindrical in form, reference will be made to the top, bottom and sides of said drum in order to describe the location of the contact plates,—reference being had to the drum or cylinder when the same is in its normal position. On the top face of the drum, contact plates 43, 44, 45, 46 and 47 are located (the plates 45 and 47 being each made in two separate sections); on the bottom face, contact plates 48 and 49 are secured, and on the side faces, contact plates 50 and 51. Contact fingers 52—53 and 54—55 coöperate with the contact plate 43; fingers 56—57 and 58—59 are arranged to be engaged by contact plate 48; fingers 60, 61 and 62—63 are disposed to coöperate with contact plate 44; fingers 64—65 and 66—67 are so located as to be engaged by contact plate sections 45; fingers 68—69 are to be engaged by contact plate 51 and fingers 70—71 are arranged to be connected by contact plate 50; fingers 72—73 and 74—75 coöperate with contact plate 46; fingers 76—77 and 78—79 coöperate with contact plate 49, and fingers 80—81 and 82—83 coöperate with contact plate sections 47.

In Fig. 1 of the drawing, a block of railway is assumed to extend from A to B, the location of these letters also denoting the location of the instruments and their circuit connections at the intersections of the continuous system of blocks of the railway.

The contact fingers 52 and 54 are electrically connected by a conductor 84 and the latter is connected by a conductor 85 with one terminal of a battery 86, the other terminal of this battery being connected, by means of a conductor 87, with one terminal of a smaller battery 88, and the other terminal of the last-mentioned battery is connected by a conductor 89 with the rail 1. At the intersections of the blocks, two sets of contact rails 8—10—11—13—14 are shown, one set for trains running in one direction and the other set for trains running in the opposite direction, and for convenience, these contact rails may be termed east-bound and west-bound contact rails,—the east-bound trains running from right to left and the west-bound trains running from left to right. The contact finger 81 of one circuit-controlling instrument (at B for instance) is connected by a line conductor 90 with a contact finger 83 of the instrument 13 at the other end of the block (as at the block terminal A Fig. 1). The contact finger 77 (at B) is connected by a line conductor 91, with a contact finger 79 (at A), and contact finger 76 (at B) is connected by a conductor 92, with a contact finger 78 (at A), the circuit of this conductor also including the magnets 93 of circuit closers 94 at A and B. A conductor 95 is connected with the rail section 4 and with the conductor 87 between the batteries 86 and 88, the circuit of this conductor including the magnet 96 of a circuit closer 97. When an east-bound train reaches the rail section 4 (at B), a circuit will be closed, which may be traced from battery 88 by conductor 87 to conductor 95 and the circuit-closer magnet 96, to rail section 4; then through truck of locomotive to rail 1 and finally, by conductor 89 to battery 88. Thus the magnet 96 will be energized to close a circuit at 97. This last-mentioned circuit may be traced from battery 86 by conductor 87 to circuit closer 97; then by a conductor 98 to one coil magnet 35, then by conductor 99 to contact finger 67, then by contact plate 45 to finger 66 (said contact plate electrically connecting the fingers 66 and 67 and also fingers 64 and 65 when the drum 19 is in normal position), then by a conductor 100 to the other coil of magnet 35, and then by a conductor 101 to battery 86. The current in this circuit will energize magnet 35 and cause the same to actuate lever 38 to turn the drum 19 from left to right, in which position it will become locked. Included in parallel with the magnets 35 are the magnets 102 of a circuit closer 103, so that when the circuit of the magnets 35 is closed and the drum 19 (at B) turned as above described, the circuit closer 103 will complete another circuit for the purpose of releasing the instrument at the end of the block to the right of B, as-

suming the train to be east-bound and just entering the block B—A. The closing of the circuit closer 103 will also short-circuit the magnets 35. For convenience in tracing the circuit controlled by the circuit closer 103, it may be well to assume temporarily that the east-bound train is just passing the block terminal A instead of B, and that the drum of the instrument at B had been shifted as above described. Thus, when the drum 19 of the instrument at A is shifted to the right and the circuit closer 103 is actuated, a circuit will be established as follows: from battery 86, by conductors 101 and 104 to circuit closer 103; then by conductor 105 to contact finger 74, through contact plate 46 to finger 75, then by conductor 106 to line conductor 91, to contact finger 77 at B, then through contact plate 49 to finger 76, then through conductor 92 and magnet 93 of circuit closer 94, to a conductor 107 at A, then by said conductor 107 to conductor 87, and by the latter to battery 86 at A. The current in this circuit, energizing the magnet 93 at B will actuate the circuit closer 94 at B to close a circuit as follows: from battery 86 at B, by conductor 85 to a conductor 108; then through the coil of releasing magnet 42; then by conductor 109 to circuit closer 94 at B, then by conductor 107 to conductor 87 and by the latter to battery 86. The releasing magnet 42 being thus energized, the drum 19 of the instrument at B will be released and permitted to move to normal position. Returning now to the assumption that an east-bound train is at B and just about to enter the block B—A,—it has been explained how, when the train reaches the rail section 4, the drum 19 of instrument at B will be shifted to the right and locked and how the drum 19 of the instrument 18 at the other end of the block to the right of B has been released and permitted to assume its normal position. It might be explained at this point that the circuit of the release magnets 41—42 for the drum 19, must be kept open as long as a train is on rail sections 3, 5, or 7. This is accomplished by means of relay 111, the energizing of which will open the circuit of the release magnet at 196. The circuits which include the release magnets and the circuit closer at 196 (when a train is on rails 3, 5 or 7) may be traced as follows: from battery 86 by conductor 85 to release magnet 41 or 42 (according to the direction in which the drum 19 has been shifted); through switch fingers 58—59 (or 56—57) and plate 48 on the drum; to conductor 202; to contacts 196 of relay 111; then by conductor 199 to rail 5; through trucks of train to rail 1 and then by conductors 89 and 87 back to battery 86. The rails 3 and 7 being electrically connected with rail 5 by conductors 115, 116 and 192, the circuit will be

as above described if the wheels of a train be upon any of said rails 3, 5 or 7. The current which energizes the magnets of relay 111 for the purpose of maintaining the circuit of the release magnets open at 196 when a train is on rails 3, 5 or 7, is derived from a battery 114. The circuit of this battery for energizing the magnets of relay 111 for the purpose above stated, may be traced as follows:—(assuming, for illustration that the instrument at B has been shifted to the right): from battery 114, by conductor 115 or 116 to rail section 3 or 5 or by conductors 191—192 to rail 7, through trucks of train to track rail 1; then by conductors 89—110 through coils of polarized relay 111; then by conductor 112 to contact finger 70 of instrument 18 at B, to finger 71; then by conductor 113 to battery 114. The east-bound train arriving at B having caused the shifting of the drum 19 at B, the following conditions will be established: The caution contact rails 8—10—11 and intermediate connections, at the right of block intersection B, will be included in a battery circuit which will be completed through signaling and controlling devices on the locomotive of a following east-bound train should such train arrive at the block intersection B while the instrument remains set as above described and before the first train reaches the block intersection A. The circuit to which reference has just been made, is established by the shifting of the drum 19 at B to the right as follows:—from battery 86, by conductor, 85 and 84 to contact finger 54; then by contact plate 43 to finger 55; then by conductor 117 to conductor 118; then by the latter to contact rail 10 at the right of block intersection B, then through signaling devices on the train (as presently explained); then by rail 1 to conductor 89 and then through battery 88 and conductor 87 to battery 86. This will operate certain signaling instrumentalities to give a caution signal or to stop the train, as will now be explained. The locomotive carries a contact shoe 118^a in position to engage the contact rails 8—10—11. The shoe 118^a is connected by conductors 119 and 120 with one terminal of a solenoid 121, the other terminal of the latter being connected by a conductor 121^a with a conductor 122. The conductor 122 is connected with one terminal of a battery 123, and the other terminal of the latter is connected by a conductor 124 with the truck frame 125. The core of the solenoid 121 is connected with an arm 126 of a pivoted block or caution signal blade 127. An east-bound train having passed block intersection B and another east-bound train having reached the contact rail 11 at the right of B, the circuits of the batteries 86—88 and 123 will be closed through the solenoid 121 and the signal blade 127 will be raised to

indicate "caution." This will indicate to the engineer that there is another train in his vicinity, in the block ahead. As the east-bound train No. 2 proceeds and its shoe 118^a engages the long contact rail 8, the signal blade 127 will be again raised (assuming east-bound train No. 1 to be still in the block ahead), and indicate to the engineer that he should "slow down." Should he disregard such "caution" signal and neglect to bring the speed of his train to a speed of say less than five miles an hour, the brakes of his train will be applied when he reaches the contact rail 10 and passes over said rail at a speed exceeding the predetermined speed of, say five miles per hour. The means whereby these results are accomplished will now be described.

A brake-controlling valve is indicated in Fig. 2 at 128 and with the stem 129 of this valve, a weighted lever 130 is connected. A lever 131 is pivoted to a fixed support and also to the stem 129 of the valve. The lever 131 is provided with a trip arm 132 to be engaged by a weighted trip lever 133 which is under the control of an electro-magnet 134. One terminal of the magnet 134 is connected, by a conductor 135 with a conductor 136 and the latter is connected with the conductor 121^a. The other terminal of the magnet 134 is connected by a conductor 137 with a contact point 138. A weighted contact lever 139 is pivotally supported in proximity to the contact point 138 and this contact lever is connected by a conductor 140 with the conductor 124. The contact lever 139 is maintained normally out of engagement with the contact point 138 as shown in Fig. 2, by means of a weighted latch lever 141 which is under the control of an electro-magnet 142. One terminal of the magnet 142 is connected, by a conductor 143 with the conductor 120, and the other terminal of said magnet is connected by a conductor 144 with a speedometer indicated diagrammatically at 145. The movable arm or shaft of the speedometer coöperates with fixed contact points, with one of which the conductor 122 is connected. Assuming now, that the train passes over the contact rail 10, at a speed greater than, say five miles an hour, the movable arm of the speedometer will engage the contact point with which the conductor 122 is connected and thus close the circuit in which the magnet 142 is included. When the contact shoe 118^a engages the rail 10, the resistance in the circuit will be reduced by the cutting out of the resistance 9 between contact rails 8 and 10. The solenoid 121 and magnet 142 will now be included in parallel and the resistance having been reduced by the cutting out of resistance 9, sufficient current will be supplied to energize both the solenoid 121 (retaining the signal blade 127 in raised posi-

tion) and the magnet 142. The result will be that the magnet 142 will actuate the latch lever 141 to release the contact lever 139 and permit the latter to drop into engagement with the contact point 138. This will close a local cab circuit including the magnet 134 and battery 123 and cause the latch lever 133 to release the lever 131 and permit the operation of the valve 128 to cause the application of the train brakes.

Returning again to the shifting of the drum 19 of instrument 18 at B when the first east-bound train reached the rail section 4, it will be observed that a partial circuit will be closed including battery 86 and contact rail 13 to the right at B, for the purpose of causing the operation of a signal blade in the cab of a following east-bound train to denote that the first east-bound train is in the block ahead, and thus a rear end collision with the first train by the second train will be avoided. Thus, when the drum 19 at B is shifted to the right, the following partial circuit will be established to put current on the contact rail 13 at the right at B: from battery 86, by conductors 85 and 84 to a conductor 146; then to finger 62; then by contact plate 44 to finger 63; then by conductor 147 to contact rail 13. The other terminal of battery 86 is connected through conductors 87—89 and battery 88 with the track rail 1. When the second or No. 2 east-bound train reaches the contact rail 13 at the right at B, a contact shoe 148 on the locomotive will engage said rail 13 and complete (in the cab) the partial circuit above described through a conductor 149, magnets 150, conductors 151, 152, 156, 121^a and 122 to battery and from said battery by conductor 124 to the truck frame 125 and from the latter to the track rail 1. When the magnet 150 is thus energized, it will actuate its armature 153 and move a tooth 154 on the same, out of the path of a trip arm projecting from a signal blade 155 which, on the drawing is marked "rear." When the signal blade 155 is thus permitted to rise, the engineer on east-bound train No. 2 will be notified that he is in rear of east-bound train No. 1 which is still in the block ahead. Train No. 2 will remain at B until the cab signal 127 returns to normal or safety positions, and this will occur when the switch drum at B is tripped and permitted to return to normal (thus opening the switch controlling circuits), when the first train passes the block intersection indicated at A, as previously explained, and the signal blade will be manually reset. When the drum 19 of instrument switch 18 at B was shifted to the right by the arrival of an east-bound train, certain partial circuits were established to operate a "head-on" signal in the cab of a west-bound train arriving at A and thus protect the east-bound

train from a head-on collision with the west-bound train between the block intersections A—B. The partial circuits last above mentioned may be traced as follows: from battery 86 at B to line 85, to line 84, to contact finger 54, contact plate 43, finger 55, conductor 117, conductor 118, contact finger 81, line conductor 90, finger 83 of instrument switch at A, contact plate 47, finger 82 and then by conductor 156 to contact rail 14 at the left at A. The remainder of this partial circuit may be traced from rail 1, conductors 89—87 and battery 88 to the battery 86. Should a west-bound train now arrived at the contact rail 14 at the left at A, the partial circuit would be completed through circuits and devices on the locomotive as follows: A shoe 157 on the locomotive arranged to engage the said contact rail 14. From this shoe the circuit can be traced by way of a conductor 158 to a magnet 159, from said magnet, by conductor 151 to conductor 152, then by conductor 136 to conductor 121^a, to conductor 122, to battery 123, and then by conductor 124 to truck frame 125 and the track rail 1. The completing of this circuit will energize magnet 159 and cause the same to actuate its armature 160 and remove a tooth 161 thereon, out of the path of a trip arm 162 on a signal blade 163 marked "head," thus releasing said signal blade and permitting it to rise and indicate that a train in the block ahead running in the opposite direction,—viz. eastward in the present instance. The first east-bound train to which reference has been hereinbefore made, will now be protected against a head-on collision as well as a rear end collision. Movement to the right of the drum 19 of switch instrument 18 at B, as before described, also operates to put current on the caution contact rails 8—10—11 at the left at A so that the cab signaling and controlling means (controlled by the current supplied to these rails,) in the locomotive of the west-bound train arriving at A, will be rendered operative. The circuit whereby these results are accomplished is in parallel with the circuit above described for putting current on the head-on signal rail 14 at the left at A, the branch to include the contact rails 8—10—11 starting at 83 at A. In order that this circuit may be more readily understood, the full circuit may be traced as follows: from battery 86 at B, by conductors 85—84 to finger 54, to plate 43 to finger 55, to conductor 117, to conductor 118, to finger 81, then by line conductor 90 to contact finger 83 at A, then by conductor 118 at A to contact rail 10 at left at A, to resistance 9, to long contact rail 8, to contact rail from one of said contact rails through cab circuits connected with shoe 118^a to track rail 1, then (if no train is in block between A and B) by conductors 89

and battery 88 to conductor 107, then by line conductor 92 to conductor 107 at left at B, and then by conductor 87 to battery 86 at B.

In Fig. 1 of the drawing, the siding 15 is shown in the block between the block intersections A and B. Should a train be on the main track between the ends of the siding, the following circuit will be established: from battery 88 at B, by conductor 89 to rail 1; through trucks of train, to a conductor 164 at A, to contact finger 70 of instrument 18 at A, by contact plate 50 to finger 71; then by a conductor 165 through the magnet 166 of a circuit closer 167 to line conductor 92, to conductor 107 at B, to conductor 87, and by the latter to battery 88. The effect of the closing of this circuit will be to close the relay 167 and thereby establish a circuit as follows: from battery 86 at A, by conductors 85—84—146 and 169 to circuit closer 167; from the latter by conductor 170 to conductor 90, to contact finger 83 of instrument 18 at A; then by conductor 118 to contact rail 10 at A; through resistance 9, contact rail 8, and conductor 12 to contact rail 11; then to contact shoe 118^a on a train arriving at A and westward bound; through the signal circuit (including solenoid 121) in the cab to rail 1, and then by conductor 89, battery 88, and conductor 87 (at A) to battery 86 at A.

From the above, it is apparent that if a train is on the main track between the ends of the siding and another train arrives at A, the latter train will receive a signal indicating that a train occupies the block ahead, and thus the train on the main track between the ends of the siding, will be protected from an approaching westbound train.

At the same time that the circuit above described is completed to cause the operation of the caution or block signal on the west-bound train arriving at A, another and parallel circuit is established for the purpose of giving to the westbound train, a "head-on" signal. This parallel circuit may be traced as follows: from contact finger 83 of instrument 18 at A, by contact plate 47 to finger 82; then by conductor 156 to contact rail 14 (at A), to contact shoe 157 (assuming that a train has arrived at contact rail 14 at A), then through the cab circuits including the magnet 159 for controlling signal blade 163; then to rail 1,—the circuit to the battery being then traced as before described.

I will now proceed to describe the circuits and devices and their operation, which protects trains when one of the trains takes the siding 15 (Fig. 1) to permit the passage of another train.

At respective ends of the siding, switches C and D are located and each comprises a movable switch bar 171 connected with and

movable by the pivoted point rail 172 of the adjacent siding switch, said switch bar having contact arms 173—174 and 175 (the arms 174 and 175 being spaced apart farther than the contact arms 173 and 174) to cooperate with contact fingers 176—177, 178—179, and 180—181. The contact rail 17 near A Fig. 1, is connected with the contact rail 16 near B, by means of a conductor 182, and said contact rails are so located between the track rails that they will be in position to be engaged by the shoe 183 on the locomotive for the purpose of closing a cab circuit to operate a switch signal in the cab. This cab circuit includes a magnet 184 having one terminal connected by a conductor 185 with the shoe 183 and having its other terminal connected, by a conductor 186 with the conductor 152. The magnet 184 controls a latch 187 which is engaged by the arm 188 of a signal blade 189, having the word "switch" indicated thereon. Thus it will be seen that when shoe 183 engages a contact rail 16 or 17, a cab circuit will be closed (the source of the current in which will be hereinafter explained), from shoe 183, by conductor 185 to magnet 184; from the latter by conductor 186 to conductors 152, 136, 121^a, and 122 to battery 123 and from the latter, by conductor 124 to the truck frame 125. The magnet 184 will thus be energized and the switch signal blade released.

Returning now to the track circuits and devices, it will be observed by reference to Fig. 1 that the circuits which the switches C and D control are the same at both ends of the block. It may be noted however, that the contact fingers 181 of the respective switches are electrically connected together by a conductor 187 and that the fingers 176 and 181 of each switch are connected by a conductor 180^a. Switch finger 176 is connected by a conductor 186 with contact rail 1, while switch finger 177 is connected, by a conductor 189 with section 6 of track rail 2. Switch finger 178 is connected by a conductor 190 with conductor 104 (at left at B and at right at A), and switch finger 179 is connected by a conductor 179^a with conductor 182. Switch finger 180 is connected by a conductor 191—115 with section 5 of track rail 2, and said conductor 191 is connected, by a short conductor 192, with section 7 of track rail 2. Referring now, to the polarized relay 111, it has already been explained how the magnets of this relay may be included in a circuit with a battery 114. By reference to Figs. 3 and 4 of the drawing, it will be observed that the armature lever 193 is pivotally supported between its ends, its lower end being disposed between the poles of the relay magnets and its upper end being located between contact devices supported horizontally near the upper ends of arms 194—195 of the relay frame. One of these

contact devices consists of a screw 196 mounted in but insulated from the arm 194. The other arm, 195, carries a contact screw 197 and a contact spring 198,—the latter being disposed between the point of screw 197 and the adjacent contact point on the armature lever 193 of the relay, and said screw 197 and spring 198 are insulated from each other and from the arm 195 of the relay frame. The armature lever 193 of the relay is connected by a conductor 199 with the section 5 of the track rail 2. The contact spring 198 of the relay is connected, by a conductor 200 with the conductor 112 and the contact 197 of the relay is connected, by a conductor 201 with the conductor 113. The contact 196 of the relay is connected by a conductor 202 with a conductor 203 and the latter is connected, by conductors 204 and 205 with contact fingers 59 and 57 respectively of instrument 18.

When a train running from west to east (right to left on Fig. 1) is to back into the siding at E (Fig. 1), the trainman will first throw the siding switch, and this will operate the switch bar 171 of the switch D. When the switch D is thus shifted, current will be put on contact rails 16 and 17, and the drum 19 of instrument 18 at A will be shifted to the right. The several circuits which accomplish these results may be traced as follows:—first: from battery 86 at A to conductor 101, to conductor 104, to conductor 190, to contact finger 178 of switch D; then by contact arm 174 to contact finger 179; then by conductor 179^a to conductor 182, and from said conductor to one or the other of the switch contact rails 16 or 17. Should a train now arrive at one or the other of these contact rails 16 or 17, so that the shoe 183 on the train would make contact with one of said rails, the circuit above described would be continued through the magnet 184 (releasing the switch signal 189) and the circuit would be completed by way of track rail 1 and conductors 89 and 87 and battery 88 to battery 86. Second: When the switch D is shifted, a circuit will be established from battery 88 by conductor 87 (at A) to conductor 95 through magnet coil 96 and by said conductor 95 to section 6 of track rail 2, to conductor 189, to finger 177 of switch D, to arm 173, to finger 176; then by conductor 188 to track rail 1 and back to battery 88 (at A) by conductor 89. The magnet 96 (at A) in the circuit above described will be actuated, and the circuit closer 97 will be thereby closed to establish the circuit (already described) in which the shifting magnets for the drum 19 of instrument 18 are included,—in the present instance the instrument at A,—causing said drum to be shifted to the right, thus putting current on the "rear end" contact rail 13 and the caution signal contact rails 11 and 8 at A. The

circuits for accomplishing these results have been hereinbefore described. Third: When the trainman closes the siding switch, the switch at D will manipulate certain circuits as follows:—The circuits controlled by the switch arm 173 and 174 and the fingers 176, 177, 178 and 179 will be opened, and the circuit controlled by switch arm 175 and fingers 180 and 181 will be momentarily closed.

When the switch arm 175 bridges the fingers 180—181 a circuit is momentarily established to unlock the drum 19 of instrument 18 at A and permit it to assume normal position and give a "clear track" for the main line: The circuit just referred to may be traced as follows: from battery 86 (at A) by conductor 85 to conductor 108 (at A), through release magnet 42 to conductor 109; then by a conductor 206 to contact finger 56 of instrument 18 at A; then to finger 57, to conductor 205; to conductor 203; to conductor 202; to contact 196 of the relay 111; then through the armature lever 193 of the relay to conductor 199; then by this conductor to section 5 of the track rail 2; then by conductor 115 to conductor 191; then to finger 180 of switch D; to finger 181; then by conductor 180^a to conductor 188, to track rail 1 and then to batteries 88 and 86 at A.

The train having moved onto the siding from the main track and the siding switch having been closed to manipulate the switch D as above explained, the instrument 18 at A will be permitted to assume its normal position, and thereby opening the battery circuits which include the contact rails and clearing the signal for the passage of a train on the main line. A train running westward can now enter the block at A and the train coming out of the siding and resetting the track instrument at A from left to right, protects that train both in front and in the rear.

Let it be now assumed that a train running westward is about to enter the block at the right of B. When the locomotive bridges rails 1 and 7, a circuit will be closed from battery 114, by conductor 113 to contact finger 71 of instrument 18 at B, to finger 70; by conductor 112 to magnets of relay 111; then by conductors 110 and 89 to track rail 1; then through trucks of locomotives to rail section 7 of track rail 2; and then by conductors 192 and 191 to battery 114. This will cause movement of the armature 193 of relay 111 to close contacts 197—198; thus affording another path for the current by way of conductors 200 and 201 connected with conductors 113 and 112 respectively, after the circuit has been opened at 70—71 by the partial rotation of the drum 19. The movement of the armature of relay 111 above described, will open the circuit which includes the contact 196 and this circuit will remain open as long as

the train bridges from rail 1 to rails 7, 5 or 3. The same train, proceeding westward, bridges rails 1 and 6, establishing the following circuit: from battery 88 (at B) by conductor 89 to track rail 1; through trucks of train to section 6 of track rail 2; then by conductor 95 (at left at B) to left hand magnet 96; then to conductor 87, and then to battery 88. Magnet 96 being thus energized closes circuit-closer 97, thus closing the circuits of the shifting magnets 36 and actuating the drum 19 from right to left and locking it in such position, in the same manner as has been hereinbefore described in connection with the shifting of said drum from left to right, and the results accomplished by the shifting of the drum from right to left are precisely the same for a train running westward from B toward the block to the right as the results hereinbefore described, for a train running eastward from B toward A when the drum was shifted from left to right. The westbound train now reaches rail section 5, and the following circuit will be established: from battery 114, by conductor 113 to conductor 201; through contacts 197—198 to conductor 200, through coils of relay 111; then by conductors 110 and 89 to track rail 1; through trucks of train to section 5 of track rail 2 and then by conductor 115 to battery 114, thus keeping the circuit of the releasing magnet open at 196. As the train proceeds it cannot shift the instrument (at B) from left to right, when it passes over section 4 of track rail 2, because, at this time, the circuit is open at 66—67 at instrument 18 at B. The train, still proceeding westward, bridges rails 1—3. The circuit thus established will be the same as when the train passed over the rail section 5, both of said rail sections being connected with the same terminal of the battery 114. The train may now enter the block at the right of B, which, for convenience, may be called B¹, although not shown on the drawings. Assume now, that after entering block B¹, it should become desirable to return the train to the siding, on account of a broken coupling, axle or wheel, or for some other reason. After the train passed rail section 3, the circuit including the coils of the polarized relay was opened and hence the armature lever again engaged the contact 196. The train, now backing, will bridge rails 1 and 3. A circuit will thus be established as follows: from battery 86 (at B) through conductor 87, battery 88, and conductor 89 to rail 1; from said rail, through trucks of train to section 3 of rail 2; by conductors 116—115 to section 5 of rail 2; then by conductor 199 to armature lever 193 of relay 111, to contact 196, to conductor 202, to conductor 203, to contact finger 59 of instrument 18 at B; to finger 58; then by conductor 207 to con-

ductor 109 (at right at B); through un-
locking or release magnet 41, to line 85, to
battery 86. The instrument 18 at B has been
now unlocked and stands at normal. The
train being backed farther, bridges rails
1 and 4 and establishes a circuit from bat-
tery 88 (at B), by conductor 89 to rail 1;
through trucks of train to rail section 4;
then by conductor 95 (at right at B) through
circuit closer magnet 96 to conductor 87 to
battery 88. Magnet 96 being thus energized,
the circuit of the shifting magnets 35 will be
closed and the drum 19 of the instrument 18
at B will be reset from left to right as has
been hereinbefore explained and the train
will be protected.

While I have shown in the drawings only
two overlapping block intersections A and
B, and described the operation of the cir-
cuits and devices with special reference to
trains arriving at and leaving these block
intersections and also the operation of the
circuits and devices when a siding exists
between the ends of a block,—it will be ap-
parent that my improvements comprehend a
continuous system of train signal and con-
trol, by means of which trains will be effec-
tually protected from danger of either
“head-on” or “rear-end” collisions. It
will also be remembered, as previously ex-
plained, that if an engineer should ignore a
warning signal, or if he should run his train
at more than a predetermined slow speed
after having received such warning signal,
his train will be stopped by the automatic
operation of the brakes of the train.

It may be desirable to provide in the cab
of the locomotive an audible signal to at-
tract the engineer's attention to the opera-
tion of the visual signals. For this pur-
pose, an electric whistle of any preferred
form of construction may be employed and
located, as diagrammatically shown at 208
in Fig. 2, in the circuit of the controlling
magnets of the visual signals.

Having fully described my invention what
I claim as new and desire to secure by Let-
ters-Patent, is:—

1. In an electrical block system, the com-
bination with track rails, contact rails, cir-
cuit shifting means at the junction of two
blocks, and signaling means on the rolling
equipment, of electro-magnetic devices for
operating the circuit shifting means, electric
circuits including said electro-magnetic de-
vices, magnetically-controlled circuit closers
in said circuits, circuits including the track
rails and rolling equipment for controlling
vices, magnetically-controlled circuit closers
partial circuits including said circuit shift-
ing means and contact rails, and partial cir-
cuits including the signaling means on the
rolling equipment to cooperate with the con-
tact rails.

2. In an electrical block system, the com-

bination with track rails, contact rails, roll-
ing equipment and signaling means on the
latter, of circuit-shifting instruments at the
junctions of the blocks, electro-magnetic
means for operating said circuit shifting
means, electrical circuits controlled by the
rolling equipment for energizing said elec-
tro-magnetic means, locking means for the
circuit shifting instruments, releasing mag-
nets for said locking means, electric circuits
controlled by one circuit shifting instrument
to energize a releasing magnet of another
circuit shifting instrument, partial circuits
including the circuit shifting instruments
and the contact rails, and partial circuits in-
cluding the signaling devices on the rolling
equipment and adapted to cooperate with
said contact rails.

3. In an electrical block signaling system,
the combination with circuit shifting means,
and track rails, of electro-magnetic means
for actuating the circuit shifting means, par-
tial electric circuits including said electro-
magnetic means, means to be controlled by
the rolling equipment for controlling said
partial circuits, a lock for said circuit shift-
ing means, a magnet for releasing said lock,
a circuit including said magnet and track
rails, a relay provided with contacts included
in the circuit of the release magnet, an
electric circuit controlled by the rolling
equipment for actuating the magnets of
said relay for opening the circuit of the re-
leasing magnet, contact rails, partial cir-
cuits including said contact rails and the
circuit shifting means, and partial signal
circuits on the rolling equipment to co-
operate with said contact rails.

4. In an electrical block signaling system,
the combination with track rails, contact
rails, rolling equipment, and signaling
means on the rolling equipment, of a circuit
shifting instrument comprising a drum hav-
ing contact plates and contact fingers co-
operating with said contact plates, electro-
magnetic devices connected with the drum
for shifting it, partial electric circuits includ-
ing said electro-magnetic devices, partial
electric circuits including contact plates and
fingers of the circuit shifting instrument and
said rails, partial circuits including the sig-
naling means on the rolling equipment and
adapted to cooperate with the contact rails,
dogs for locking the drum when shifted,
electro-magnets for moving said dogs to
release the drum, and circuits controlled by
the rolling equipment and including last-
mentioned electro-magnets.

5. In an electrical block signaling system,
the combination with track rails, contact
rails, and rolling equipment, of a drum pro-
vided with a plurality of contact plates, a
plurality of pairs of contact fingers to co-
operate with said contact plates, partial
circuits including said contact plates, con-

tact fingers, track rails and contact rails, electro-magnetic devices located at respective sides of said drum and connected therewith for shifting the same, circuits controlled by the rolling equipment and including said electro-magnetic devices, a weight connected with said drum at respective sides of its axis for returning it to normal position, a disk carried by said drum and having diametrically opposite shoulders, pivoted arms having teeth to engage said shoulders, to lock the drum in shifted position, electro-magnetic devices for withdrawing said arms,

circuits controlled by the rolling equipment and including the last-mentioned electro-magnetic devices, signaling devices on the rolling equipment, and partial circuits including said signaling devices and coöperative with the track rails and contact rails. 15

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses. 20

ANDREW J. ALLARD.

Witnesses:

M. J. MICKOLS,

WM. P. REDD.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."