No. 700,302. Patented May 20, 1902.

W. M. CHAPMAN & W. PESTELL.

RAILWAY BLOCK SIGNALING SYSTEM.

(Application filed May 8, 1901.)

(No Model.) 4 Sheets—Sheet 1.

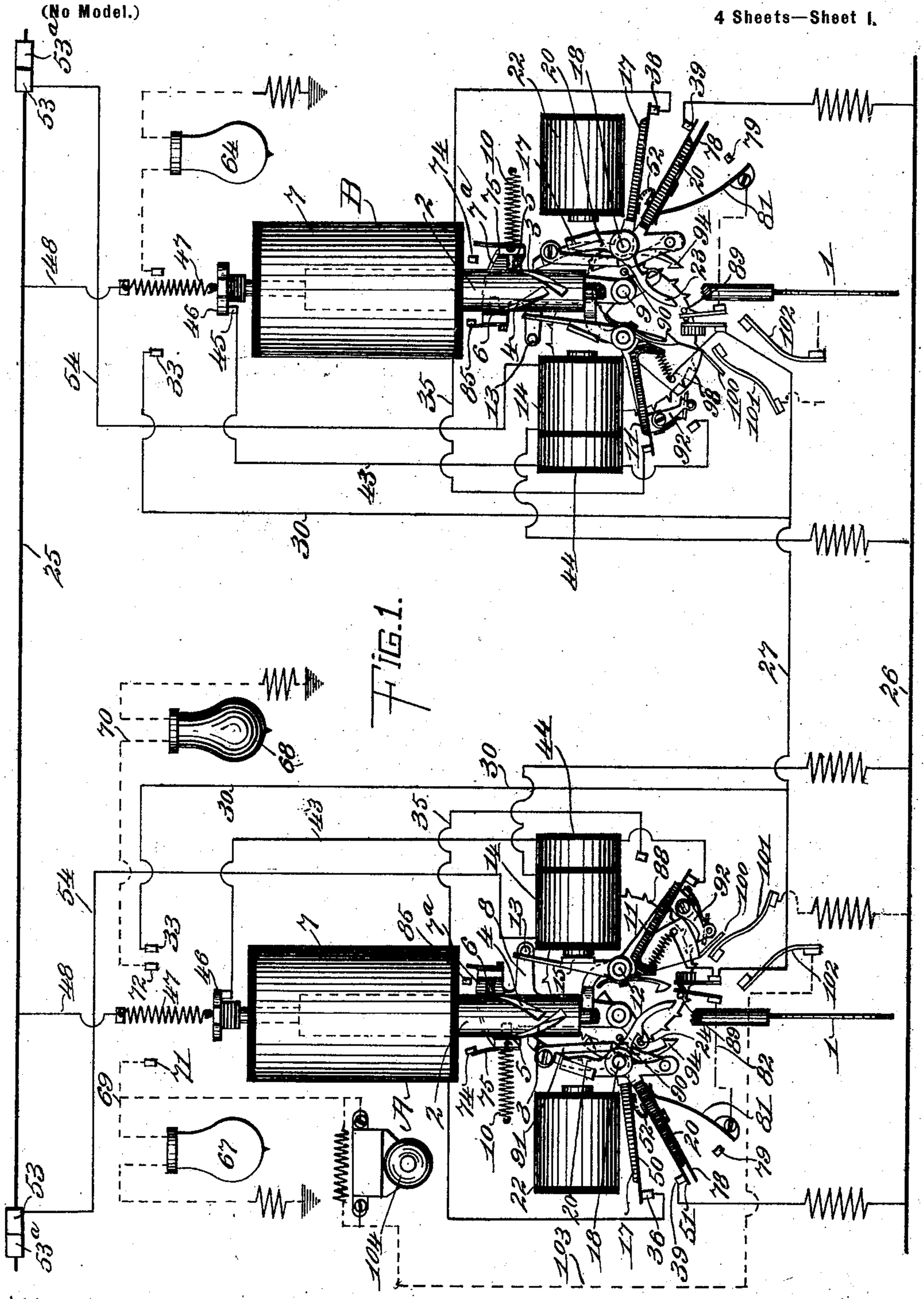

FIG. 1.

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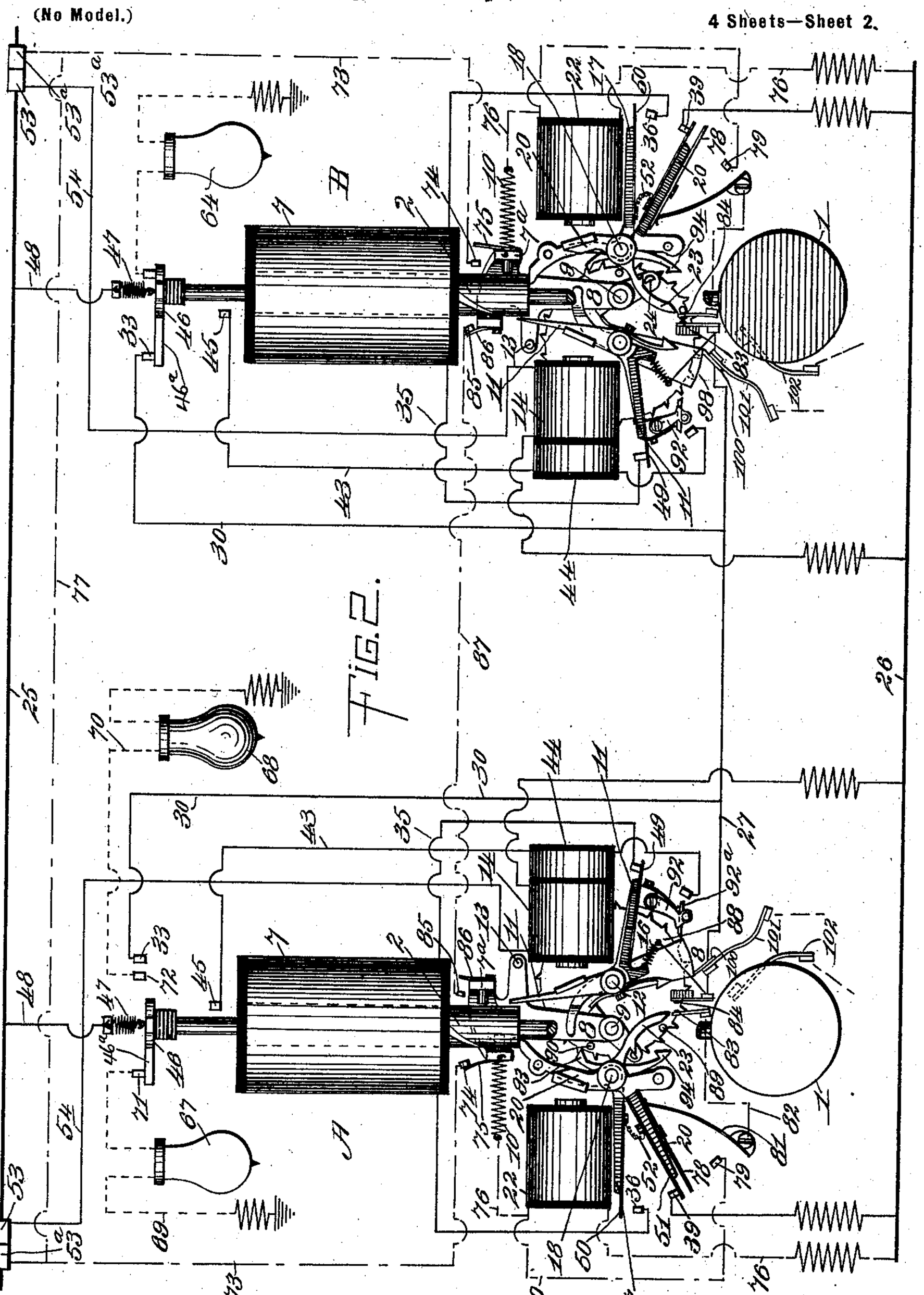

FIG. 2.

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(No Model.) 4 Sheets—Sheet 3.

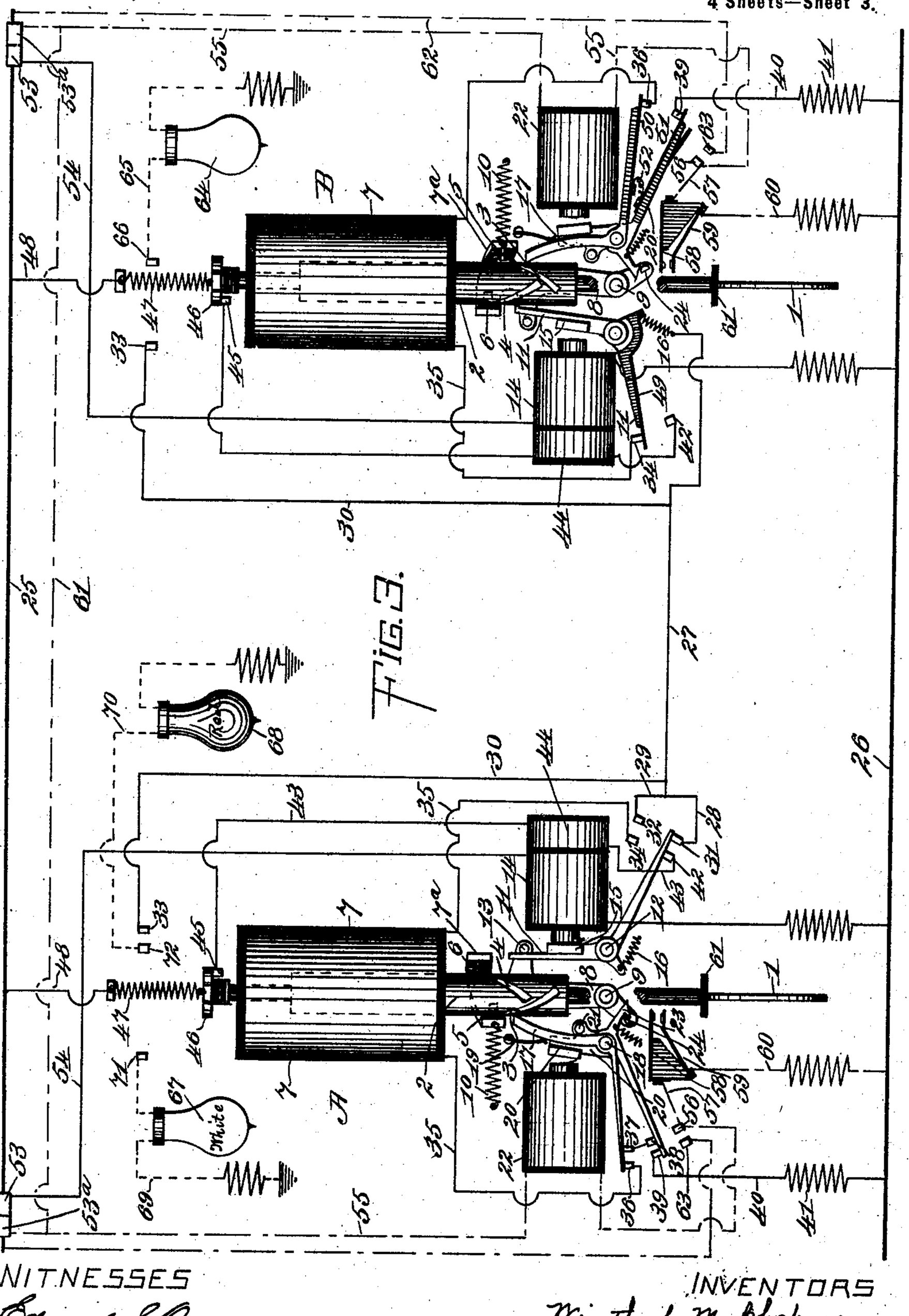

FIG. 3.

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(Application filed May 8, 1901.)

(No Model.) 4 Sheets—Sheet 4.

FIG. 4.

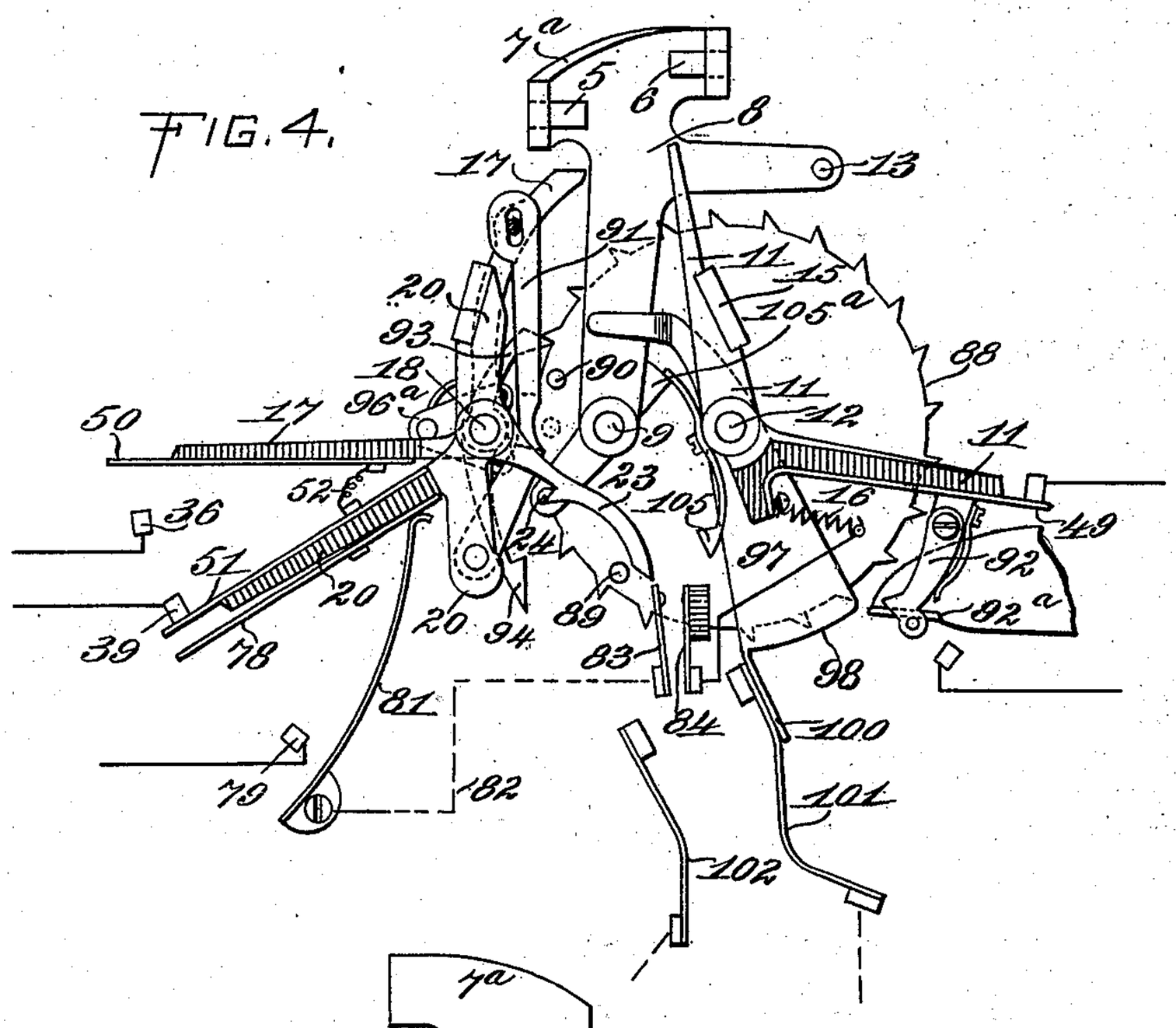
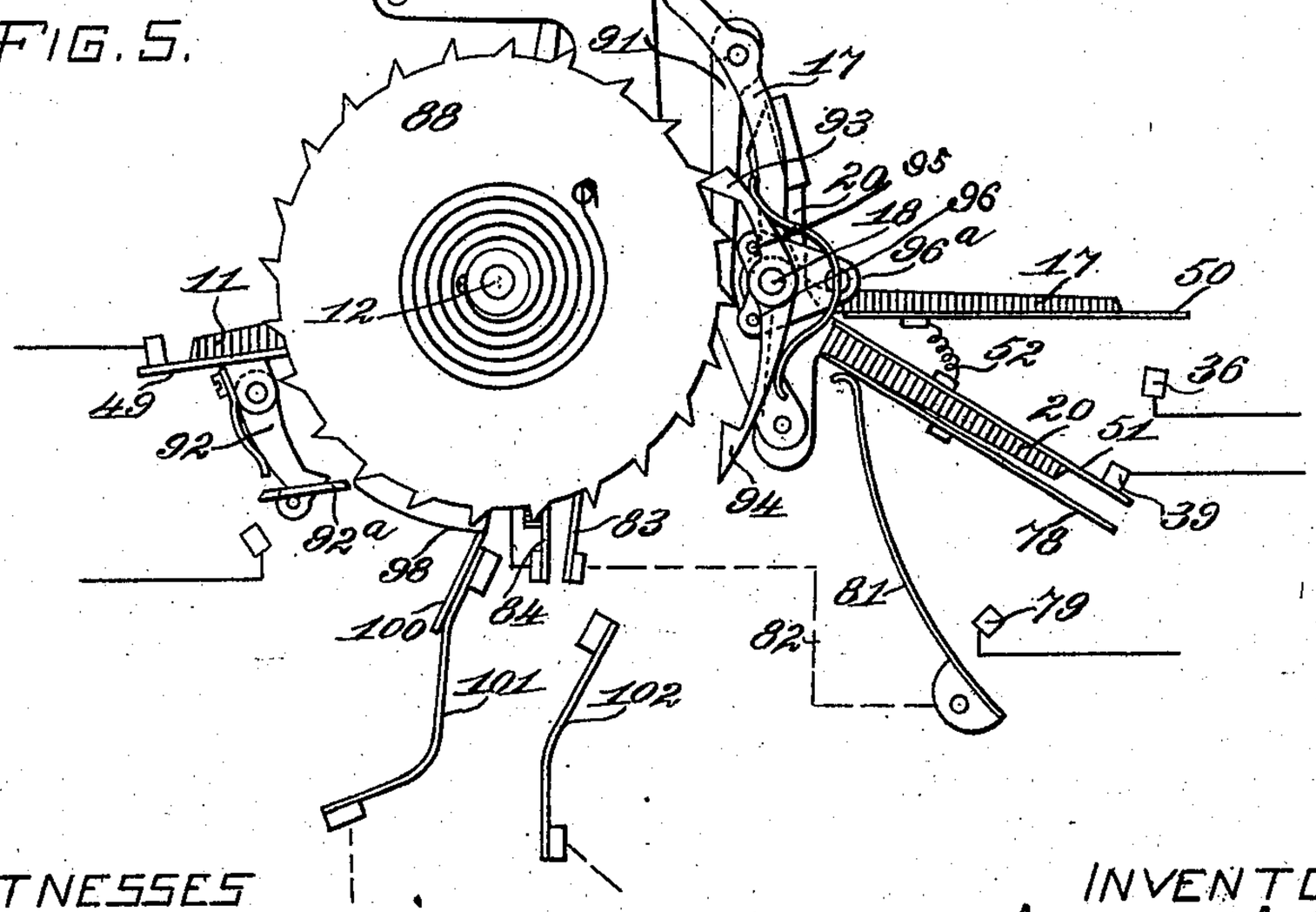


FIG. 5.



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WINTHROP M. CHAPMAN, OF NEWTON, AND WILLIAM PESTELL, OF LYNN, MASSACHUSETTS.

RAILWAY BLOCK-SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 700,302, dated May 20, 1902.

Application filed May 8, 1901. Serial No. 59,273. (No model.)

To all whom it may concern:

Be it known that we, WINTHROP M. CHAPMAN, residing at Newton, in the county of Middlesex, and WILLIAM PESTELL, residing at Lynn, in the county of Essex, State of Massachusetts, citizens of the United States, have invented certain new and useful Improvements in Railway Block-Signaling Systems; and we 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.

The present invention relates to railway block-signaling systems.

The object of our invention is to provide an improved railway block-signaling system, and more particularly an electrical block-signaling system, which shall be certain in operation and in which the number of operating parts, line-wires, and connections are reduced to a minimum.

Other objects of our invention are to improve the signaling apparatus of such a system and in general to improve the construction, mode of operation, and arrangement of the various parts of such a system.

With these objects in view our invention consists in the devices, combinations, and arrangements hereinafter described and claimed, the advantages of which will be obvious to those skilled in the art from the following description.

Our invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram showing the apparatus and circuit connections for a track-section or block of a signal system embodying our invention, the apparatus being shown in the position which it assumes at the moment a car enters the block from the left and the circuits of the magnets for actuating the locking devices to release the signals being omitted for the sake of clearness. Fig. 2 is a view similar to Fig. 1 with the circuits of the magnets for actuating the locking devices to release the signals added thereto, the signals being set and the apparatus being in the position which it assumes when a second car enters the block from the left before the first car has left the block. Fig. 3 is a diagram showing the apparatus and connections for a track-section or block of a signaling system embodying certain features of our invention. Fig. 4 is a view, on an enlarged scale, of the mechanism shown in Figs. 1 and 2 with the magnets and signal omitted; and Fig. 5 is a view similar to Fig. 4 looking in the opposite direction.

In the embodiments of our invention shown in the drawings a signal is provided at each end of a track-section or block and an actuating mechanism for each signal, both of said mechanisms being rendered operative to set a signal when a car enters the block from either direction. It is to be understood, however, that certain features of our invention are not limited to a signal system in which the signals are so arranged and operated, nor are the various features of our invention limited, except as defined in the claims, to any particular form of apparatus nor to any particular arrangement of connections or circuits.

Referring first to Fig. 3, in which is illustrated diagrammatically the circuits for a single block of an electrical signaling system embodying certain features of our invention and also somewhat diagrammatically the signaling apparatus for said block, A indicates a signaling apparatus at one end of the block, and B a signaling apparatus at the other end of the block. Each apparatus comprises a signal movable from normal to either of two positions, actuating mechanism therefor, means for determining the position to which the signal is moved by its actuating mechanism, and a locking device for the signal. The signal consists of a target 1, the opposite faces of which are of different colors, one face preferably being white and the other red. Normally the target is in a position so that neither side is visible from an approaching car, and in order to set the target in a position to display either side the target is rotated in one direction or the other. For so actuating the target a rod 2 is provided, to the lower end of which the target 1 is secured. The rod 2 is provided with right and left spiral grooves 3 and 4, with which pins 5 and 6 are adapted to engage, respectively, the arrangement being such that a longitudinal movement of the rod 2 when one of the pins is in engagement with a groove will cause

a rotary movement of the rod and of the target attached thereto, the direction of rotation of the rod, and consequently the side of the target displayed when the signal is set, depending on which pin is in engagement with its coöperating groove. In this connection it is to be noted that among other equivalent constructions threads might be provided upon the rod in place of the grooves, and devices coöperating with the threads might be provided in place of the pins. The rod 2 is attached to or forms the lower portion of the core of an electromagnet 7 of the solenoid type, which acts when energized to raise the rod 2 and cause the rotation thereof, as above described. For the proper actuation of the signal it is necessary that one of the pins should be in engagement with a groove and that the other pin should be disengaged from its coöperating groove. In order to accomplish this result, we mount the pins 5 and 6 in the opposite ends of a yoke 7^a, secured to or formed integral with the upper end of a pivoted arm or lever 8, the pivot of which is indicated at 9. By swinging the arm 8 in either direction one of the pins 5 or 6 is brought into engagement with its coöperating groove and the other pin removed from the other groove. The arm 8 is acted upon by a spring 10, which normally holds the arm in a position to cause the pin 6 to be in engagement with the groove 4. When the rod 2 is raised with the arm 8 in this position, the rod is rotated in a direction to cause the red side of the target 1 to be displayed. For moving the arm 8 into a position to cause the pin 5 to engage the groove 3 and the rod 2 to be rotated in a direction to display the white side of the target 1 a lever 11, pivoted at 12, is provided, the upper end of which extends into a position to coöperate with a pin 13, projecting from the arm 8. The lever 11 is actuated to move the arm 8 against the tension of the spring 10 by means of an electromagnet 14, the armature 15 of which is secured to the lever 11. A suitable retractile spring 16 serves to move the lever in the opposite direction. After the target 1 has been moved into a position to display either the white or red side the current through the actuating-magnet 7 is broken, as will be hereinafter described.

In order to lock the signal in the position in which it has been moved, a locking-lever 17, pivoted at 18, is provided, the upper end of which is pressed against the surface of the rod 2 by means of a leaf-spring 19 when the rod is in its lowest position, as shown in Fig. 3, and which is forced beneath the shoulder of the rod when the rod is in its highest position. In order to actuate the locking-lever to disengage the shoulder of the rod 2 and allow the target 1 to return to normal position, a lever 20 is also pivoted at 18 and provided with a laterally-projecting pin 21, which is arranged to engage the locking-lever 17 and move it in a direction to disengage the shoulder of rod 2. The lever 20 is moved in a direction to actuate the locking-lever 17 to release the signal by means of an electromagnet 22, the armature of which is secured to the lever 20. The circuit of the magnet 14 is only momentarily closed, as will be hereinafter described, and in order to lock the arm 8 in the position to which it is moved when the magnet 14 is energized an arm 23 projects from the lever 20 and is provided with a hook which is arranged to engage a pin 24, projecting laterally from a portion of the arm 8 extending below the pivot 9. By this means the arm 8 is held in the position to which it has been moved by the energization of magnet 14 after the magnet is deënergized and before the rod 2 is raised by the magnet 7. When the rod 2 is raised, the groove 4 is moved out of alinement with the pin 6, and the arm 8 is then prevented from being returned to its normal position by the contact of the end of the pin 6 with the surface of the rod.

The circuits for the magnets 14, 7, and 22 and the means for opening and closing the circuits to cause the proper actuation of the signal apparatus will now be described.

25 represents a trolley-wire of an electric railroad or other suitable source of current, and 26 the rail or other return-circuit.

27 is a single line-wire, through which current is transmitted to the magnets 7 of both signal apparatus A and B. At the left as viewed in Fig. 3 the line-wire 27 is connected by means of wires 28, 29, and 30 to contacts 31, 32, and 33. Adjacent to the contact 32 is a contact 34, which is connected to a wire 35, leading to the magnet 7 of apparatus A and then to a contact 36. Adjacent to the contact 36 is a contact 37, which is connected by means of a wire to a contact 38. Adjacent to the contact 38 is a contact 39, and this contact is connected by means of a wire 40, including a suitable resistance 41, to the return-circuit 26. Adjacent to the contact 31 is a contact 42, to which is connected a wire 43, which leads to a coil 44 of the magnet 14 and then to a contact 45. To the upper end of the rod 2 is secured an insulated plate 46, which when the rod is in its lowest position, as shown in Fig. 3, rests upon contact 45. The plate 46 is connected through the counterbalancing-spring 47 for the rod 2 and the wire 48 to the trolley-wire 25. For bridging the contacts 32 34 and 31 42 the lower end of the lever 11 is extended into a position to engage either pair of contacts, and thus act as a switch to open and close the circuits, including both sets of contacts. When the lever 11 is in a position to bridge the contacts 32 and 34, a circuit including the line-wire and the magnet 7 is closed at this point, and when the lever is in a position to bridge the contacts 31 and 42 the circuit including the magnet 7 is open and a circuit including the main line 27 and coil 44 of magnet 14 is closed at this point. For bridging the contacts 36 37 and 38 39 the extended lower ends of le-

vers 17 and 20 are utilized, as will be apparent without further description. The circuit connections and contacts of apparatus A, above described, are duplicated in apparatus B, with the exception that the line-wire 27 is connected to an insulated contact-plate 49 on lever 11, and thereby contacts 31 and 32 are dispensed with. Also insulated plates 50 and 51 are secured to levers 17 and 20 and connected by means of a wire 52, whereby the contacts 37 and 38 are dispensed with.

At each end of the block and in a position to be operated by a car entering the block from that end is a circuit-closer or switch 53, which when actuated connects the trolley-wire 25 with a wire 54, which leads to the main coil of the magnet 14, and thence to a suitable resistance and to the return 26. By means of the circuits and connections above described the magnets 7 and 14 of the signaling apparatus at both ends of the block can be energized to cause the targets to be moved to the desired positions, as will now be described.

The normal position of the apparatus at both ends of the block is as indicated in Fig. 3, except that the lever 11 of apparatus A is in a position to bridge the contacts 32 and 34, the magnet 7 of the apparatus A being connected to the main line, as well as the magnet 7 of apparatus B. When a car enters the block from the left as viewed in Fig. 3, the circuit-closer or switch 53 at that end of the block is actuated, and a current is transmitted through the wire 54 and main coil of magnet 14, thereby energizing the magnet and moving the lever 11 against the tension of spring 16. This movement of the lever moves the arm 8 into the position shown in Fig. 3, in which position pin 5 is in engagement with slot 3 and pin 6 is disengaged from slot 4. Also the line-wire 27 is disconnected from wire 35 and connected to wire 43 by means of the lower end of the lever. By the bridging of contacts 42 and 31 a closed circuit is established from the trolley-wire 25 to the return 26, including the magnet 7 of apparatus B, as follows: wire 48, spring 47, plate 46, contact 45, wire 43, coil 44 of magnet 14, contacts 42 and 31, and wire 28 at apparatus A, line-wire 27, plate 49, and contact 34, wire 35, magnet 7, contact 36, plate 50, wire 52, plate 51, contact 39, and wire 40 of apparatus B. The circuit-closer 53 is preferably operated by the car in passing onto the block, and consequently the closure of the circuit including main coil of magnet 14 is momentary. In order to insure the circuit through the magnet 7 of apparatus B being held closed until the magnet is energized and the signal set, the coil 44 is included in the circuit established through the magnet 7, said coil acting to prevent the deënergization of the magnet 14 when the circuit through the main coil of the magnet is broken. When the magnet 7 of apparatus B is energized, the rod 2 of said apparatus is raised and the target moved to a position to display the red side, as the magnet 14 of apparatus B has not been energized, and consequently pin 6 is in engagement with groove 4. When the target has been moved into a position to display the red side, the lever 17 is forced beneath the shoulder of rod 2 and the signal locked in position. The movement of lever 17 to its locking position raises the plate 50 from contact 36, thereby breaking the circuit which has been established through the magnet 7 of appartus B and the auxiliary coil 44 of apparatus A. The breaking of this circuit deënergizes magnet 14 and allows spring 16 to move the lever 11 into a position to bridge the contacts 32 and 34, thereby connecting the magnet 7 of apparatus A to the line 27. Plate 46 of each apparatus is provided with an arm similar to the arm 46[a], (shown in Fig. 2,) and this arm of apparatus B is turned by the movement of rod 2 in setting the signal so as to contact with contact 33. The signal of apparatus B having been set, the lever 11 of apparatus A having been turned to a position to bridge contacts 32 and 34, as above described, and the arm of plate 46 of apparatus B having come in contact with contact 33, a circuit from trolley-wire 25 to return 26, including the magnet 7 of apparatus A, is established as follows: wire 48 of apparatus B, spring 47, plate 46, contact 33, wire 30, line-wire 27, wire 29 of apparatus A, contacts 32 34, wire 35, magnet 7, contacts 36 37 38 39, and wire 40. This circuit remains closed until the magnet 7 of apparatus A is energized and the target moved to display one side, in this case the white, since the arm 8 is locked by the engagement of hooked arm 23 with pin 24 in a position to cause pin 5 to be in engagement with groove 3. After the rod 2 has been raised the lever 17 is forced beneath the shoulder of the rod to lock the target in position and in moving to locking position breaks the circuit through the magnet 7 of apparatus A at the contacts 36 and 37. When both signals are in their normal position and a car enters the block from the right as viewed in Fig. 3, the operation is the same as above described, except that apparatus A is actuated as was apparatus B when a car enters the other end of the block and apparatus B is actuated as was apparatus A, as will be apparent without further description.

From the foregoing it will be seen that means are provided at each end of the block whereby the actuating mechanisms of the signals can be rendered operative to set both signals. It will also be seen that the signal at the distant end of the block is set first and that the signal at the entering end cannot be set until the signal at the distant end has been moved by its actuating mechanism and locked in position. The signal at the entering end thus affords an indication that the signal at the distant end has been set.

When both signals are set, it will be seen that the circuits of both magnets 7 are broken

by the locking-levers for the signals. In order to avoid any possibility of the signals being improperly actuated in case a second car enters the block, the circuits of the magnets 7 are also broken by the separation of plates 46 and contact 45.

When a car leaves the block, it is necessary that both locking-levers be actuated in order to release the signals and allow the signaling apparatus to return to normal position. In order to so actuate the locking mechanism, the following circuits and connections are provided: At each end of the block a circuit-closer or switch 53^a is provided, from which a wire 55 leads to the magnet 22 and thence to a contact 56. The contact 56 is connected by means of a wire 57 to one of two contact-plates 58 and 59, the other of which is connected by means of a wire 60 to the return-circuit 26. The contact-plates 58 and 59 are arranged in the path of movement of a flange 61, preferably of insulating material, secured at the lower end of rod 2, the arrangement being such that when the rod has been raised to move the target 1 into a position to display either side the plates 58 and 59 are moved into contact and a circuit from switch 53^a at the trolley-wire 25 to the return 26, including magnet 22, is closed at this point. The wires 55 at each end of the block are connected by means of a wire 61, so that when the signals are set and the circuit-closer 53^a actuated by a car leaving the block parallel circuits are formed from the trolley-wire 25 to the return 26, including the magnets 22. The closure of the circuit by the circuit-closer or switch 53^a when a car leaves the block is momentary, and it is possible that circumstances might arise that would render such momentary closure while sufficient to energize one of the magnets 22 insufficient to energize the other magnet. It is therefore desirable that means be provided to insure the restoration of both signals and prevent any possibility of the momentary closure acting to restore one signal and leave the other set. In order to insure the energization of both magnets 22 and the release of both signals, we provide a wire 62 at each end of the block, which leads from the trolley-wire 25 to a contact 63 in proximity to the contact 56. In case but one of the magnets 22 is energized the contacts 56 and 63 are bridged at that end of the block and a circuit is established from the trolley-wire 25 to the return 26, including both magnets 22, said circuit consisting of the wire 62 at the end of the block at which the magnet 22, which has been actuated, is located, contacts 63 and 56, wire 55, wire 61, wire 55 at the other end of the block, contact 56, wire 57, contacts 58 and 59, and wire 60. The contacts 56 and 63 are bridged to establish this circuit by means of the lower end of lever 20 when the lever is actuated by the energization of magnet 22. This circuit is held closed until the signal at the other end of the block is returned to normal position, when it is broken by the separation of contacts 58 and 59.

For night signaling it is desirable to provide lamps which are lighted when the signals are set, and such lamps can be arranged either to render the target visible or to serve as signals independently of the target. In Fig. 3 we have shown one apparatus provided with a lamp arranged to render the target visible and the other apparatus provided with lamps which serve as signals independently of the target, it being understood that either arrangement of lamps can be used at each apparatus, if desired, and that it is unnecessary to use both arrangements at the same apparatus. Thus we have shown the apparatus B as provided with a lamp 64 for the purpose of rendering the target visible, one terminal of the circuit 65 of said lamp being grounded and the other terminal constituting a contact 66. The contact 66 is arranged in the path of movement of the plate 46 in the upper end of the rod 2, so that when the signal is set a circuit is closed through the lamp 64 from the trolley-wire 25 to the ground consisting of wire 48, spring 47, plate 46, contact 66, and wire 65. We have shown apparatus A as provided with two lamps 67 and 68, which serve as signals independently of the target 1, one of said lamps being white and the other red. The circuit-wires 69 and 70 of these lamps are grounded at one end and at the other end connected to contacts 71 and 72, located above and on each side of the plate 46. The circuits through one or the other of these lamps is closed by means of the contacts 71 and 72 and the arm of the plate 46, the circuit closed depending on the direction in which the rod 2 is rotated. In this last-described arrangement it will be seen that the lamps 67 and 68 are the equivalent of the target and constitute an alternative form of signal which may be used in place of the target.

The signal system illustrated in Fig. 3 and above described is designed to prevent a second car entering the block from either direction while a car is on the block, the signal at the entering end serving to give an indication that the signal at the distant end has been set as well as to prevent another car entering the block from the same direction. In the system shown in Fig. 3 the signals are returned to normal position whenever a car leaves the block, and consequently the system cannot be used satisfactorily on railroads where it is desirable or necessary to allow a plurality of cars to be in the block at the same time. In order to provide a system in which the signals will be properly actuated when a second car enters a block from the same direction before the first car has left the block, it is necessary to provide means whereby the signals are returned to normal position only when the last car to enter a block leaves the same. In Figs. 1 and 2 we have illustrated such a system, which embodies the novel features of the system illustrated in Fig. 3 and

other novel features, as will appear from the following description: Referring to said figures, A and B designate signaling apparatus at each end of a track-section or block, as in Fig. 3. Each apparatus comprises a signal 1, a vertically-movable and rotatable rod 2, to which the target or signal is secured, pins 5 and 6 for engaging spiral grooves 3 and 4 in the rod 2 to cause the rod 2 to rotate in either direction, an actuating-magnet 7, an arm 8, a lever 11, and a magnet 14 for actuating lever 11, the construction and mode of operation of these parts being the same as the parts correspondingly numbered in Fig. 3 and above described. The arrangement of the circuits for the magnets 7 and 14 and the means for opening and closing the circuits are also the same as in the system illustrated in Fig. 3. It may be noted, however, that the line-wire 27 is connected to a plate on the lever 11 at the left of the figure and that contacts 37 and 38 are omitted and plates 50 and 51 secured to levers 17 and 20 and connected by wire 52 provided, the arrangement being the same as in the apparatus at the right of Fig. 3. Each apparatus A and B is provided with a locking-lever 17 and with a magnet 22 for actuing the locking-lever to release the signal, as in the apparatus illustrated in Fig. 3.

The system illustrated in Figs. 1 and 2 is designed to permit a second car to enter the block from the said direction before the first car leaves the block and while the signal at the entering end of the block is set. In such a system it is of great importance that the signal at the entering end of the block be returned to normal position, as well as the signal at the distant end, when the last car leaves the block, for if the signal at the entering end, which shows white, should remain set and the signal at the distant end, which shows red, be returned to normal position a car coming from one direction would be allowed to enter the block by the presence of the white signal and a car coming from the other direction might perhaps enter the block in spite of the fact that the apparatus at that end was not operated to show the white signal. In order to prevent any possibility of the red signal being returned to normal position unless the white signal is also returned and to serve as an indication that the white signal has been returned to normal position, we provide an arrangement whereby the return of the red signal is dependent upon and cannot be accomplished until after the return of the white signal. The circuit arrangements by which this result is accomplished are illustrated in Fig. 2, in which 73 indicates wires at each end of the block, each wire extending from a circuit-closer 53^a to a contact 74. At each apparatus the yoke 7^a of arm 8 is provided with an upwardly-projecting yielding contact-plate 75, which when the arm 8 is moved into a position to cause pin 5 to engage slot 3 strikes contact 74. The contact-plate 75 is in electrical connection with the spring 10, and the spring is connected to wire 76, which leads to magnet 22, and then to a suitable resistance and to return 26. The wires 73 are connected by a wire 77, so that when the circuit-closer 53^a at one end of the block is actuated to connect the wire 73 to the trolley-wire 25 and the apparatus at the other end of the block is in the position which it assumes when the white side of target 1 is displayed, such being the position of the apparatus at the left of Fig. 2, a circuit is formed from the wire 25 to the return 26, as follows: wire 73 at one end of the block, wire 77, wire 73 at the other end of the block, contacts 74 75, yoke 7^a, spring 10, wire 76, and magnet 22. The closure of this circuit causes magnet 22 to attract its armature and move the lever 20 in a direction to actuate the locking-lever 17 and release the signal. The actuation of lever 20 brings a contact-plate 78, carried thereby, in contact with a contact 79, which is connected by means of a wire 80 to the wire 76 between the magnet 22 and contact 75. At each apparatus a spring 81 bears against contact-plate 78 and is connected by means of a wire 82 to a spring contact-plate 83, adjacent to a contact-plate 84, which is connected to the line-wire 27. At the opposite side of the rod 2 from contact 74 is a contact 85, with which a contact-plate 86, secured to the yoke 7^a, is arranged to engage when the arm 8 is in a position to cause pin 6 to engage slot 4. The contact-plates 85 of apparatus A and B are connected by means of a wire 87. Both signals being set in the positions shown in Fig. 2, in which positions the target at the left shows white and the target at the right shows red, and the contact-plate 83 of apparatus A being pressed against contact-plate 84 by means to be hereinafter described, the engagement of plate 78 with contact 79 closes a circuit from trolley-wire 25 to return 26 through magnet 22 of apparatus A, as follows: wire 48 of apparatus A, spring 47, plate 46, contact 33, wire 30, line-wire 27, contacts 84 and 83, wire 82, spring 81, plate 78, contact 79, wire 80, magnet 22 of apparatus A, and wire 76. A circuit through magnet 22 is thus maintained after the circuit-closer 53^a is released by the car leaving the block. The magnet 22 is thus energized so as to hold the locking-lever 17 out of contact with the rod 2 a sufficient length of time to insure the return of the signal to its normal position. When the signal is returned to normal position, the groove 4 in rod 2 will come into alinement with pin 6, and the arm 8 will be moved by the spring 10 in a direction to cause contact 86 to engage contact 85 and contact 75 to disengage contact 74. A circuit will thus be established from trolley-wire 25 to return 26 through the magnet 22 of apparatus B, as follows: to wire 80, as before, wire 76, spring 10, yoke 7^a, contacts 86 and 85, wire 87, contacts 85 and 86 of apparatus B, yoke 7^a, spring 10, wire 76, and magnet 22. This circuit remains closed until the locking-lever of apparatus B is actuated to release rod

2 and the signal is returned to its normal position, when the circuit is broken by the separation of plate 46 at the upper end of rod 2 and contact 33.

In a system such as illustrated in Figs. 1 and 2, which is designed to permit a second car to enter the block before the first car leaves the block, it is necessary to provide means for preventing the restoration of the signals until the last car leaves the block. To accomplish this result, we provide a controller for the actuating mechanism of the locking devices which allows the locking devices to release the signals only when the last car leaves the block. As shown in the drawings, each apparatus A and B is provided with a controller. It may be well to state at this point, however, that but one of these controllers is in operation at one time, each controller being constructed and arranged to control the actuating mechanism of the locking devices of both signals. In the arrangement shown in the drawings the controller of the apparatus which is actuated to display the white side of the target is used to control the actuating mechanism of the locking devices of both signals, the controller of the other apparatus being at rest and prevented from accidental actuation, as will be described.

The controller shown in the drawings (see more particularly Figs. 4 and 5) consists of a ratchet-wheel 88, mounted concentric with the pivot 12 of lever 11. This ratchet-wheel is provided with two laterally-projecting pins 89 and 90. When the ratchet-wheel 88 is in normal position, the pin 89 presses the contact-plate 83 against the contact-plate 84 and holds the circuit of magnet 22, above described, closed at this point. When the ratchet-wheel 88 is in normal position, the pin 90 is in a position to cause the locking-lever 17 to be actuated to release the rod 2 when the magnet 22 is energized. The upper end of lever 17 is connected by means of a bent link 91 to a portion of lever 20 projecting below its pivot 18. When the ratchet-wheel 88 is in normal position, the pin 90 is in a position to contact with the link 91 when the arm 20 is actuated by the magnet 22. The contact of the pin with the link causes the upper end of the link to force the locking-lever 17 out of engagement with the rod 2. When the ratchet-wheel 88 is moved forward one or more steps, the pin 89 allows the contacts 83 and 84 to separate, and the pin 90 is moved out of the path of movement of link 91, the link swinging on the upper end of the lever 17 as a pivot without actuating the lever. The ratchet-wheel 88 is moved forward step by step when cars enter the block and is returned toward its normal position step by step when cars leave the block, as will now be described. A spiral spring having one end attached to the wheel and the other end attached to some fixed part of the apparatus tends to move the ratchet-wheel 88 in a direction to press pin 89 against contact 83. For moving the ratchet-wheel against the tension of the spring a spring-pressed pawl 92 is pivoted to the lower end of lever 11, the arrangement being such that when the lever 11 is actuated by the magnet 14 the pawl will move the ratchet-wheel forward a distance somewhat greater than the distance between two teeth.

For holding the ratchet-wheel in its advanced position a spring-pressed detent 93, pivoted on pin 18, is provided. Also pivoted on pin 18 is a spring-pressed detent 94, which extends in the opposite direction from the detent 93, and said detents constitute an escapement for permitting the step-by-step return movement of the ratchet-wheel 88 under the influence of its actuating-spring as magnet 22 is actuated. Pins 95 and 96 project from a plate 96^a, secured to pin 18 beneath the detents 93 and 94, and are so arranged that when the magnet 22 is deënergized and the lever 20, which is also secured to pin 18, is in its retracted position the detent 93 is in engagement with the ratchet-wheel and the detent 94 is out of engagement therewith. When the lever 20 is moved by the magnet 22 and then returned to its retracted position, the detents 93 and 94 are actuated to allow the ratchet-wheel to move backward one step or tooth, as will be obvious. When the lever 11 is in its retracted position, the pawl 92 is held out of engagement with the teeth of the ratchet-wheel 88 by a guide 92^a on a fixed part of the apparatus, which engages a pin in the end of the pawl.

The magnet 14 is energized and the lever 11 actuated each time a car enters the block, and magnet 22 is energized each time a car leaves the block, as has been described. In order to cause the actuation of the locking device to release the signal, it is necessary that the ratchet-wheel 88 be in normal position when the magnet 22 is energized. It is therefore necessary to prevent the ratchet-wheel 88 being moved forward when the first car enters the block, as otherwise when the car leaves the block the energization of magnet 22 will not cause the release of the signals. To this end we provide a lever 97, pivoted at 12 concentrically with the ratchet-wheel 88, which is provided at one end with a surface 98, which when the signal is in its normal position is arranged to engage the pawl 92 and hold the pawl out of engagement with the teeth of the ratchet-wheel. The lever 97 is held in this position by means of the shoulder on the rod 2. When the rod 2 is raised and the signal set, the lever 97 drops and allows the pawl 92 to engage the teeth of ratchet-wheel 88. When the signal is set, the arm 97 or a finger 100, extending therefrom, bears against a spring contact-plate 101. This plate is connected by a wire through a suitable resistance to return 26 and is arranged adjacent to contact 102, which is connected by means of a wire 103 to circuit-wire 69 of lamp 67. In the wire 103 is arranged a vibrating bell 104 or other suitable signal,

the purpose of which will be hereinafter described.

In case a car enters the block at the same instant that another car is leaving the block, it is necessary that the ratchet-wheel 88 be moved forward to prevent the contact of link 91 with pin 90 and the actuation of locking-lever 17 when magnet 22 is energized by the actuation of circuit-closer 53ª by the car leaving the block and to move the pin 89 away from contact 83 to prevent the closing of the circuit of magnet 22 when the contact-plate 78 engages contact 79, and it is also necessary that the ratchet-wheel 88 should be returned to normal position in order that the locking devices of the signal may be actuated when the car next leaves the block. When a car enters the block at the same instant that another car leaves the block, the magnets 14 and 22 are simultaneously energized and levers 11 and 20 actuated. The pawl 92 moves the ratchet-wheel forward, and thereby prevents the actuation of the locking-lever by the movement of the lever 20 and separates the contacts 83 and 84. If now the lever 20 were allowed to be returned before the lever 11, the detent 93 would engage the next tooth in advance of the ratchet-wheel 88 and hold the ratchet-wheel in the position to which it has been moved by the pawl 92. In order to prevent this result and insure a return of ratchet-wheel 88 to its initial position, the retracting movement of lever 20 is delayed until after the lever 11 has been retracted sufficiently to allow the ratchet-wheel 88 to be moved backward, so that the detent 93 will engage the same tooth as before. To so delay the movement of lever 20, the lever 11 is provided with a hook or latch 105, which engages the end of the hooked arm 23 of lever 20 when both levers 11 and 20 are actuated simultaneously. The lever 20 is thus held from movement by the lever 11 until the lever 11 is retracted sufficiently to disengage the hook 105 from the end of arm 23.

In order to prevent the pin 6 from being crowded out of groove 4 when the target is to be moved to display the red side, the rear end of latch 105 is extended beneath a lug 105ª, projecting from the side of arm 8. By this construction the arm 8 is held from movement about its pivot so long as lever 11 remains in retracted position, but is allowed to move to bring pin 5 into engagement with groove 3 by the withdrawal of the latch from beneath the lug when the lever 11 is moved by magnet 14.

The operation of the signaling system illustrated in Figs. 1 and 2 may be briefly described as follows: Supposing the block to be empty and both signals in their normal position, when a car enters the block from the left the signals at both ends of the block will be set, as was explained in the description of the operation of the system illustrated in Fig. 3, the target of apparatus B being turned to display the red side and the target of apparatus A being turned to display the white side. When the signals were in their normal position, the arm 97 was held by the shoulder on rod 2 in a position to prevent the engagement of pawl 92 with the teeth of ratchet-wheel 88 during the movement of lever 11. The entrance of the first car onto the block therefore sets both signals, but does not cause any movement of the ratchet-wheel 88. When the signal of apparatus A is set, the lever 97 is allowed to drop to bring the projection 100 on the lever into engagement with the spring-contact 101, the contacts 101 and 102, however, remaining separated. When the next car enters the block from the left, it being supposed that the first car is still on the block, the magnet 14 is again energized and the pawl 92, which is now allowed to engage the teeth of ratchet-wheel 88, actuated to move the ratchet-wheel forward until the detent 93 engages the next tooth. During its forward movement the pawl 92 engages the end of lever 97 and presses the projection 100 against the contact 101, thereby pressing the contacts 101 and 102 together. A circuit including the vibrating bell 104 is thereby established between the trolley-wire 25 and return 26, as follows: wire 48, spring 47, plate 46, contact 41, a portion of wire 69, wire 103, contacts 102 and 101, and a wire connecting contact 101 with return 26. The bell 104 thus serves to indicate that the controller has been actuated when a car enters the block to prevent the return of the signals to normal position when the preceding car leaves the block. If a third car enters the block before the first car leaves the block, the ratchet-wheel 88 is moved forward another step and the circuit of bell 104 again closed for the purpose just described. The position which the parts of apparatus A and B assume after a second car has entered the block from the left is indicated in Fig. 2. With the parts in this position when a car leaves the block a circuit is momentarily closed from wire 25 to return 26, consisting of a portion of wire 73 at apparatus B, wire 77, wire 73 at apparatus A, contacts 74 and 75, yoke 7ª, spring 10, wire 76, and magnet 22. The magnet 22 being energized attracts its armature and moves the lever 20 in a direction to disengage the detent 93 from the teeth of ratchet-wheel 88 and allow detent 94 to engage the ratchet-wheel. The detents are so arranged that when so actuated the ratchet-wheel is allowed to move backward a short distance. The movement of lever 20 brings contact-plate 78 into engagement with contact-plate 79. The circuit through these contacts is, however, open at contacts 83 and 84, and as soon as the car passes out of the block the magnet 22 is deënergized and lever 20 returned to its original position, the detent 93 engaging the next tooth of the ratchet-wheel 88, which has thus been allowed to move backward a distance equal to the distance between two teeth. This backward movement of the ratchet-wheel 88 brings the pin 90 into the path of move-

ment of link 91 and the pin 89 into contact with the contact-plate 83, thereby pressing the contacts 83 and 84 together. When now the second car leaves the block, the magnet 22 is energized, as before. The movement of lever 20 forces link 91 against pin 90, which acts to remove the locking-lever 17 from engagement with rod 2 and allows the rod to drop to its normal position. The movement of lever 20 also brings plate 78 in contact with contact 79, thereby closing a circuit from the wire 25 to return 26, consisting of wire 48, spring 47, plate 46, contact 33, wire 30, line-wire 27, contacts 84 and 83, wire 82, spring 81, plate 78, contact 79, wire 80, wire 76, and magnet 22. The magnet is thus maintained energized after the car has left the block and the original circuit broken at the circuit-closer 53ª. When the signal of apparatus A has thus returned to its normal position, the arm 8 is moved by spring 10 to bring the contact 86 in engagement with the contact 85. A circuit is thus closed from the wire 25 to return 26 through the magnet 22 of apparatus B, as follows: to contacts 84 and 83, as before, wire 82, spring 81, contacts 78 and 79, wire 80, wire 76, spring 10, yoke 7ª, contacts 85 and 86, wire 87, contacts 85 and 86 of apparatus B, yoke 7ª, spring 10, wire 76, and magnet 22. By the energization of magnet 22 of apparatus B the locking-lever of the apparatus is actuated and the signal returns to normal position. In so returning the circuit through magnet 22 is broken by the separation of the arm of plate 46 at the upper end of rod 2 and contact 33.

The operation when a car enters the block from the right is the same as above described, the apparatus B operating as did apparatus A and apparatus A operating as did apparatus B, as will be understood without further description.

The operation when a car enters the block at the same instant that a car leaves the block will be understood from the description already given. When the signals have been set in the position shown in Fig. 2, it will be seen that the controller of apparatus A acts to control the actuating mechanism of the locking devices of both signals and that the controller of apparatus B remains in its normal position and has no effect upon either signaling apparatus. It is also to be noted that means are provided whereby any accidental actuation of the controller of apparatus B is prevented. Thus an actuation of ratchet-wheel 88 of apparatus B is prevented by the contact of lever 11 with pin 13, even if the magnet 14 of apparatus B is accidentally energized, the pin 13 being arranged to prevent a movement of lever 11 sufficient to advance the ratchet-wheel 88 a distance equal to the distance between two teeth. Energization of the magnet 22 of apparatus B, except by the closing of the circuit hereinbefore described, is prevented by the separation of the contacts 74 and 75 when the signal is set in the position shown in Fig. 2.

We are aware that a signal system has been devised in which a signal apparatus is provided at each end of a track-section or block and in which the actuation of the apparatus at the entering end of the block is controlled by the apparatus at the distant end of the block. In such system, however, duplicate sets of apparatus are required for cars going in both directions, one set being operated by cars going in one direction and the other set being operated by cars going in the opposite direction. Certain features of our invention as defined in the claims are distinguished from this system in that the same set of apparatus is utilized for cars going in both directions. Other features, however, are otherwise distinguished and are not limited to a system in which the same set of apparatus is arranged to be operated by cars going in both directions.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism for each signal, means at both ends of the block for rendering said mechanisms operative to set both signals, locking devices for said signals, actuating mechanism therefor, and means at both ends of the block for rendering said mechanism operative to actuate the locking devices to release the signals, substantially as described.

2. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism for each signal, means at each end of the block for rendering the actuating mechanism of the signal at the other end operative to set a signal, and means actuated by the setting of one signal for rendering the actuating mechanism of the other signal operative to set a signal, substantially as described.

3. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, means at both ends of the block for rendering said magnets operative to set both signals, locking devices for said signals, actuating mechanism therefor, and means at both ends of the block for rendering said mechanism operative to actuate the locking devices to release the signals, substantially as described.

4. A railway block-signal system, having, in combination, a signal, an operating-magnet therefor, a circuit including said magnet, car-controlled means for closing said circuit and a magnet in said circuit for maintaining said circuit closed, substantially as described.

5. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, circuits for said magnets, switches in said circuits, actuating means therefor, means at each end of the block for rendering said actuating means operative to close the

circuit of the magnet at the other end and means actuated by the setting of one signal for rendering said actuating means operative to close the circuit of the operating-magnet of the other signal, substantially as described.

6. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, means at each end of the block for rendering the magnet at the other end operative to set a signal, and means actuated by the setting of one signal for rendering the magnet of the other signal operative, substantially as described.

7. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, circuits for said magnets, means for closing said circuits, and a locking device for one of the signals acting to control the means for closing the circuit of the magnet of the other signal, substantially as described.

8. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, means at one end of the block for rendering the magnet at the other end operative to set a signal, and a locking device for said signal acting to render the magnet of the other signal operative, substantially as described.

9. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, a single line-wire, circuits for said magnets including said line-wire, means for closing said circuits, and means actuated by the setting of one signal for controlling the means for closing the circuit of the magnet of the other signal, substantially as described.

10. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism therefor, a locking device for each signal, an electromagnet for actuating each locking device to release a signal, means for closing a circuit including one of said magnets and means controlled by said magnet for closing a circuit including the other magnet, substantially as described.

11. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism therefor, a single controller acting to control the return of both signals to normal position, means operating independently of the controller for rendering said mechanism operative to set both signals and means rendered operative by cars entering and leaving the block for actuating the controller to prevent the return of the signals until the last car leaves the block, substantially as described.

12. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism therefor, a locking device for each signal, means for actuating said locking devices to release the signals, a controller, and means rendered operative by cars entering and leaving the block for actuating the controller to prevent the actuation of said locking devices until the last car leaves the block, substantially as described.

13. A railway block-signal system, having, in combination, a signal, actuating mechanism therefor, a locking device for said signal, means for actuating said locking device to release the signal, a controller, means rendered operative by cars entering the block for actuating the controller to prevent the actuation of said locking device, means rendered operative by cars leaving the block to actuate the controller to permit the actuation of said locking device, and means for preventing the actuation of said controller when a car enters an empty block, substantially as described.

14. A railway block-signal system, having, in combination, a signal, actuating mechanism therefor, a locking device for said signal, means for actuating said locking device to release the signal, a controller, means rendered operative by cars entering the block for actuating the controller to prevent the actuation of said locking device, means rendered operative by cars leaving the block to actuate the controller to permit the actuation of said locking device, and means for causing the controller to be actuated successively by both of said actuating means when two cars enter and leave the block simultaneously, substantially as described.

15. A railway block-signal system, having, in combination, a signal, means for actuating said signal when a car enters the block, a locking device for said signal, means including a magnet for actuating said locking device to release the signal, a circuit for said magnet, means for closing said circuit at one point when a car leaves the block, a controller acting to open and close said circuit at another point, and means for actuating the controller in a direction to open said circuit when a car enters the block and for actuating the controller in a direction to close said circuit when a car leaves the block, substantially as described.

16. A railway block-signal system, having, in combination, a signal, actuating mechanism therefor, a locking device for said signal, means including a magnet for actuating said locking device to release the signal, a circuit for said magnet, means for closing said circuit, a step-by-step controller, and means for actuating said controller in a direction to maintain said circuit open when a car enters the block and for actuating the controller in a direction to permit the closing of said circuit when a car leaves the block, substantially as described.

17. A railway block-signal system, having, in combination, a signal movable from normal to a plurality of positions, actuating mechan-

ism therefor and means for determining the position to which the signal is moved by said mechanism, substantially as described.

18. A railway block-signal system, having, in combination, a target rotatable in opposite directions from normal position to display either side, means for rotating the target and means for determining the direction of rotation, substantially as described.

19. A railway block-signal system, having, in combination, a target, a rod for actuating said target provided with right and left spiral grooves, means for moving the rod longitudinally and means for engaging either groove to cause the rod to rotate in either direction, substantially as described.

20. A railway block-signal system, having, in combination, a target, a rod for actuating said target provided with right and left grooves, means for moving the rod longitudinally, means for engaging either groove to cause the rod to rotate in either direction, two lamp-circuits and means actuated by the rod to close one circuit when the rod is rotated in one direction and to close the other circuit when the rod is rotated in the opposite direction, substantially as described.

21. A railway block-signal system, having, in combination, a signal, an operating-magnet therefor, a circuit including said magnet, car-controlled means for closing said circuit, means for maintaining said circuit closed, and means actuated by the setting of the signal to break said circuit, substantially as described.

22. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, circuits for said magnets, means for closing said circuits, means at the entering end of the block for rendering said means operative to close the circuit of the magnet at the distant end, means actuated by the setting of the signal at the distant end for rendering said means operative to close the circuit of the magnet at the entering end, and means actuated by the setting of the signal at the entering end to break the circuit of the magnet at the distant end, substantially as described.

23. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, an operating-magnet for each signal, a line-wire, circuits for said magnets including said line-wire, means for closing said circuits, means at each end of the block for controlling the closing of the circuit of the magnet at the other end, and means actuated by the setting of either signal for controlling the closing of the circuit of the magnet of the other signal, substantially as described.

24. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, means for moving each signal from normal to either of two positions, and means at each end of the block for rendering said means operative to move the signals to different positions, substantially as described.

25. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism therefor, a locking device for each signal, a magnet for actuating each locking device to release a signal, means for closing a circuit including one of said magnets, means controlled by said magnet for closing a circuit including both magnets, and means controlled by said last-mentioned magnet for opening said circuit, substantially as described.

26. A railway block-signal system, having, in combination, a signal, actuating mechanism therefor, a controller acting to control the return of the signal to normal position, means rendered operative by cars entering and leaving the block for actuating the controller to prevent the return of the signal until the last car leaves the block, and means for indicating an actuation of the controller when a car enters the block, substantially as described.

27. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism therefor, a locking device for each signal, means for actuating said locking devices to release the signals, a controller, and means rendered operative by cars entering and leaving the block for actuating the controller to prevent the actuation of said locking devices until the last car leaves the block, and means for indicating an actuation of the controller when a car enters the block, substantially as described.

28. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism for each signal, a locking device for each signal, means for actuating said locking devices to release the signals, a controller at each signal acting to control the actuation of both of said locking devices, actuating mechanism therefor, and means at both ends of the block for rendering the actuating mechanism of both signals operative to set the signals, and to render the actuating mechanism of one of the controllers operative, substantially as described.

29. A railway block-signal system, having, in combination, a signal at each end of a track-section or block, actuating mechanism for each signal, a locking device for each signal, means for actuating said locking devices to release the signals, a controller at each signal acting to control the actuation of both of said locking devices, actuating mechanism therefor, means at both ends of the block for rendering the actuating mechanism of both signals operative to set the signals, and to render the actuating mechanism of one of the controllers operative, and means actuated by the setting of the signals for preventing the actuation of the other controller, substantially as described.

30. A railway block-signal system, having, in combination, a signal at each end of a track-

section or block, means for successively setting said signals and means for successively restoring said signals, substantially as described.

31. A railway block-signal system, having, in combination, a signal, actuating mechanism therefor, means for rendering said mechanism operative to set the signal, means for restoring the signal, a controller for said restoring means, and means rendered operative by cars entering and leaving the block for actuating the controller to prevent the restoration of the signal until the last car leaves the block, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

WINTHROP M. CHAPMAN.
WILLIAM PESTELL.

Witnesses:
FRED O. FISH,
ALFRED H. HILDRETH.