No. 865,013. PATENTED SEPT. 3, 1907.

W. M. CHAPMAN.

RAILWAY BLOCK SIGNAL SYSTEM.

APPLICATION FILED JAN. 24, 1906.

6 SHEETS—SHEET 1.

Fig. 1.

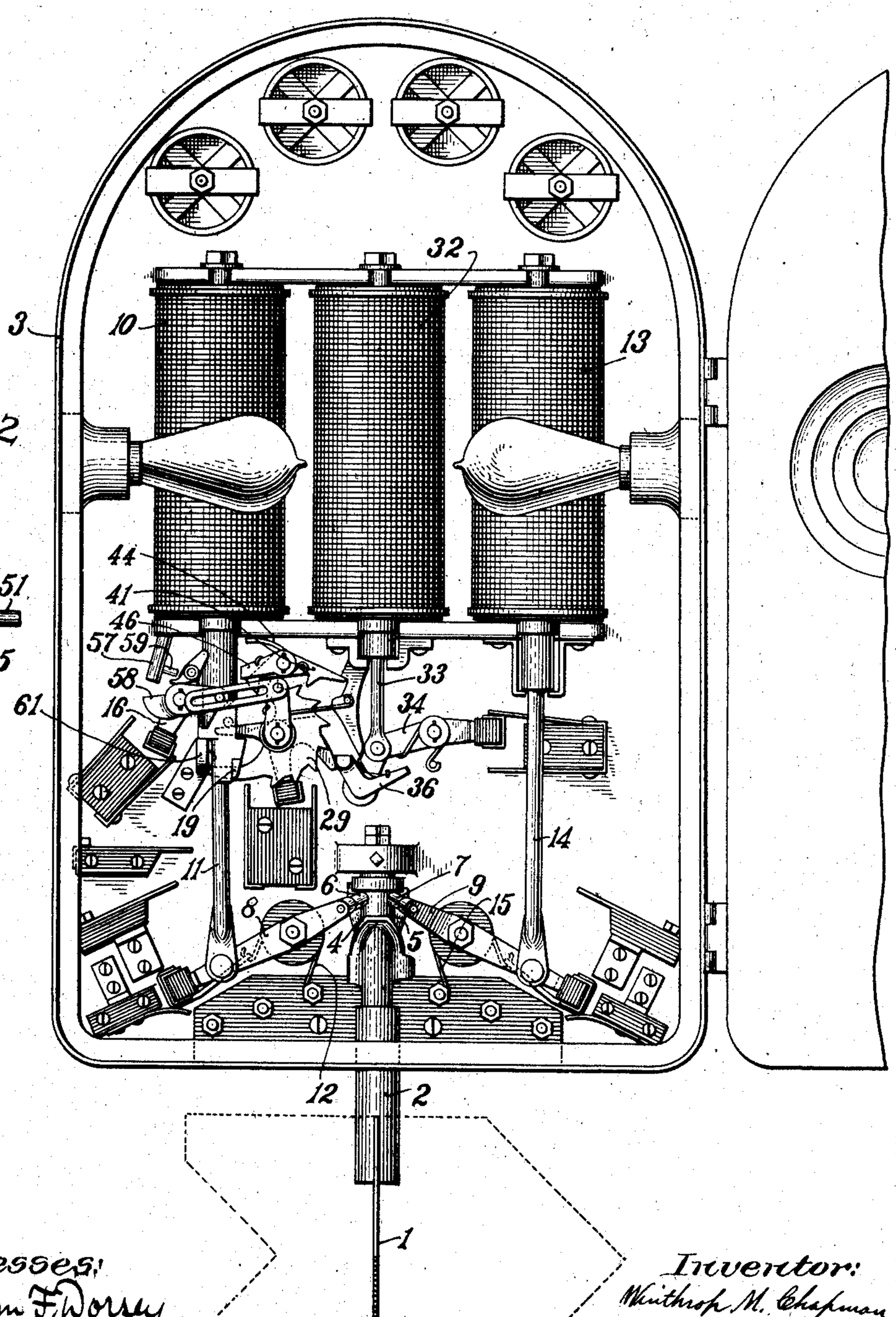
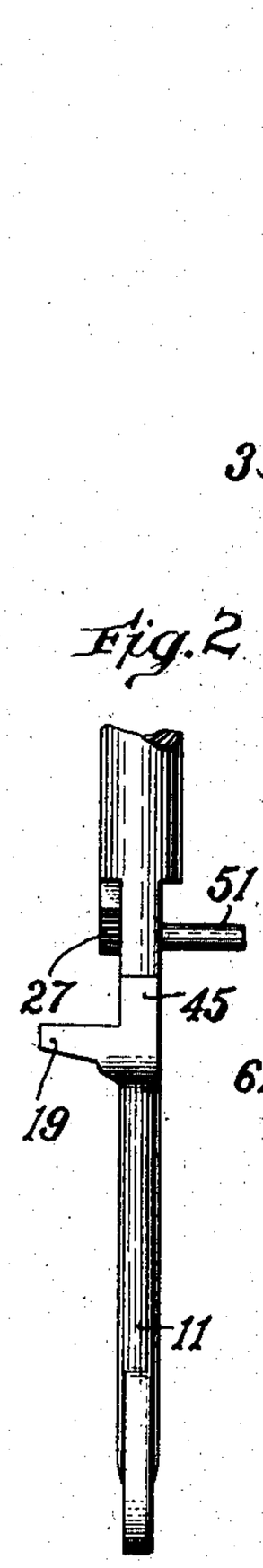


Fig. 2



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5 SHEETS—SHEET 2.

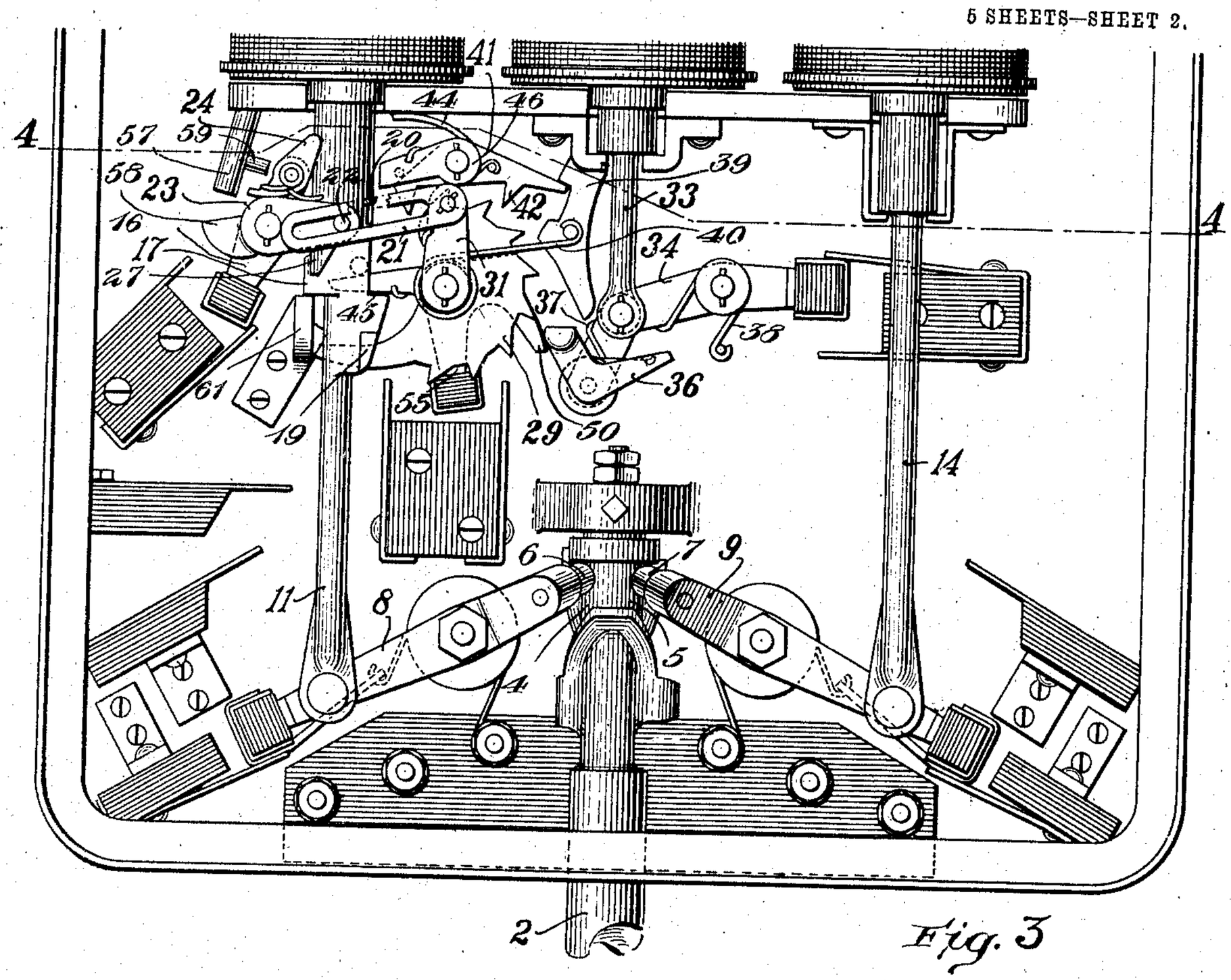

Fig. 3

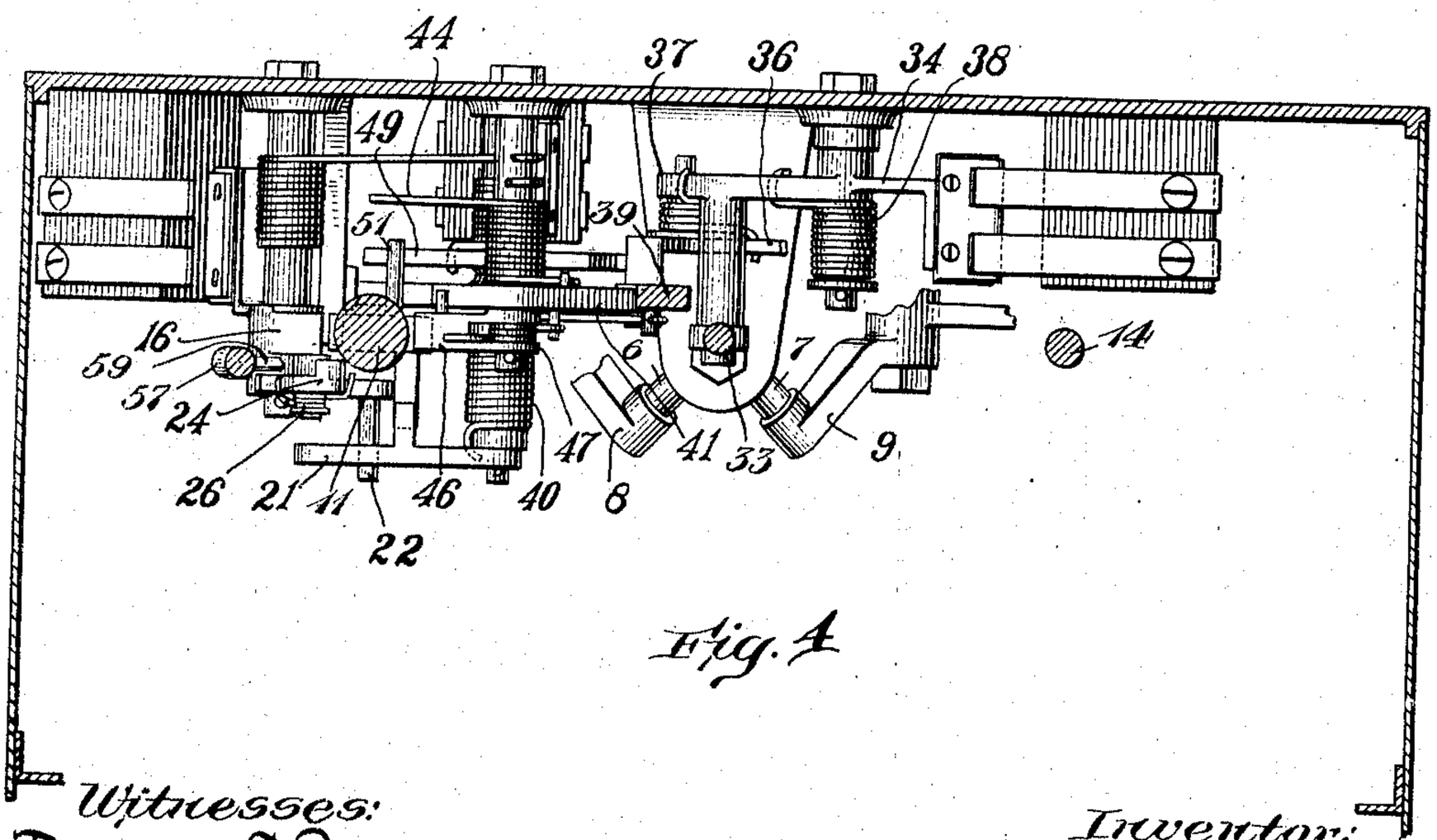

Fig. 4

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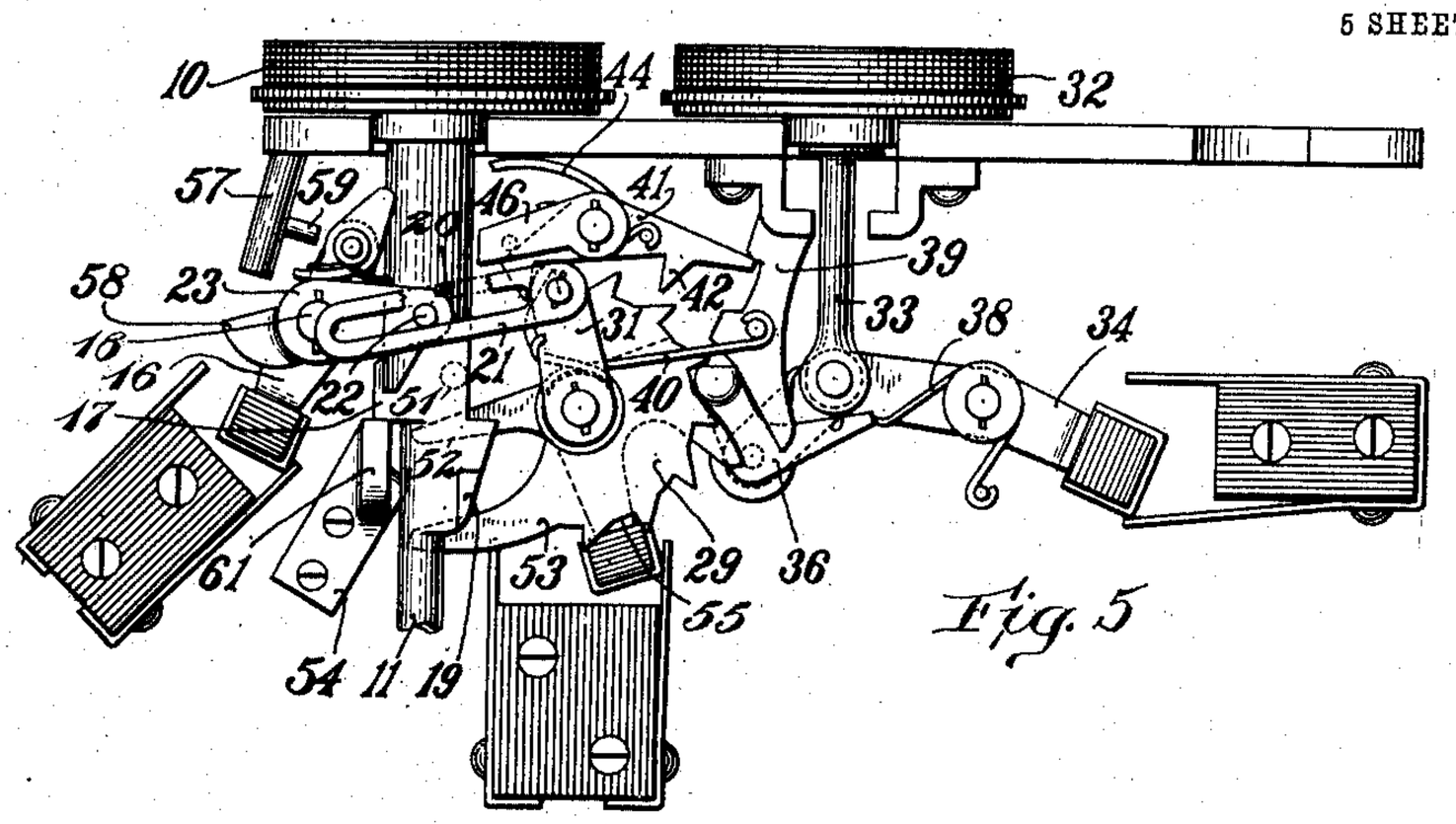

Fig. 5

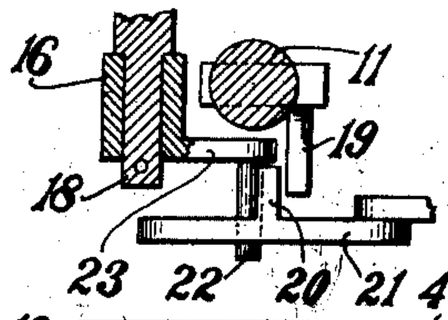

Fig. 6

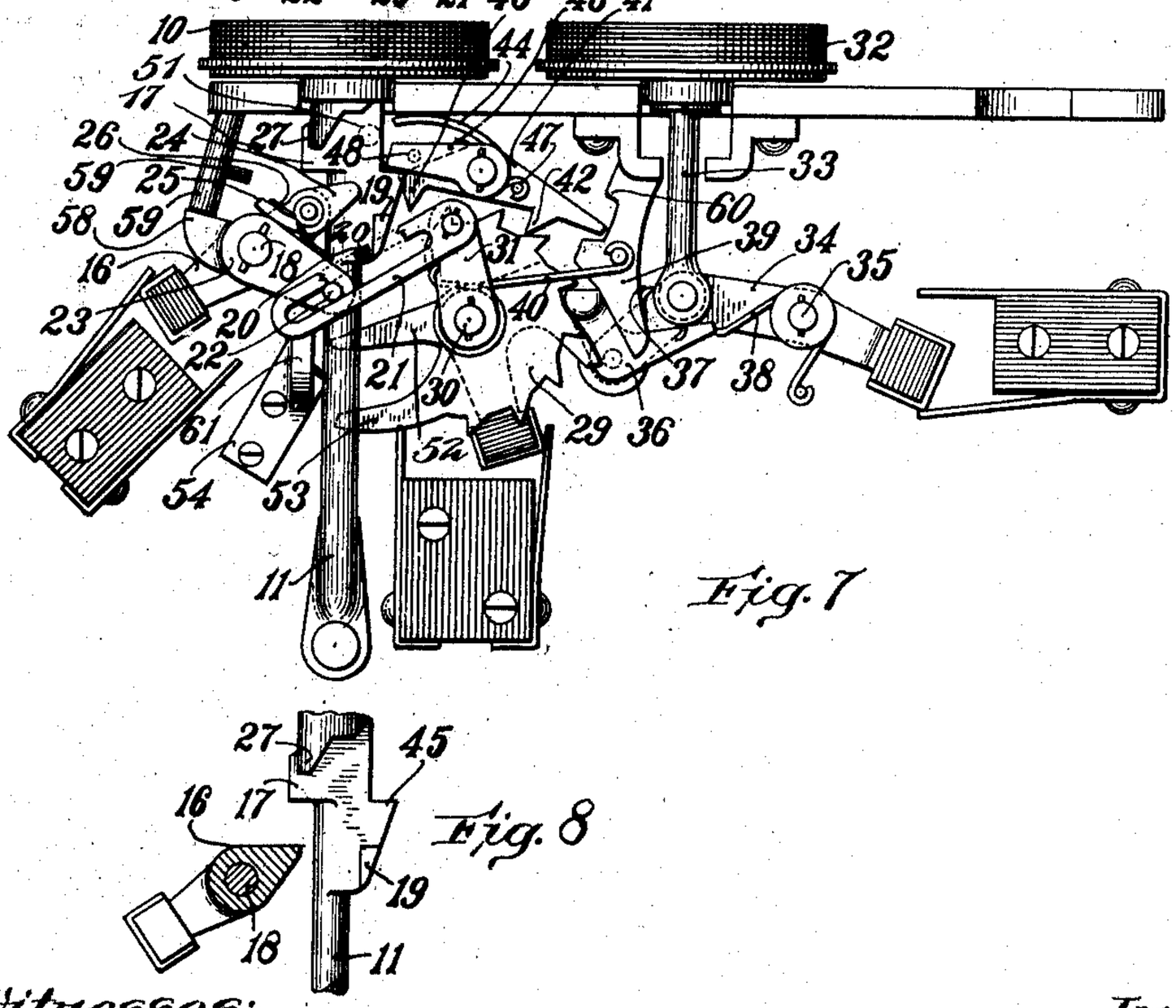

Fig. 7

Fig. 8

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5 SHEETS—SHEET 4.

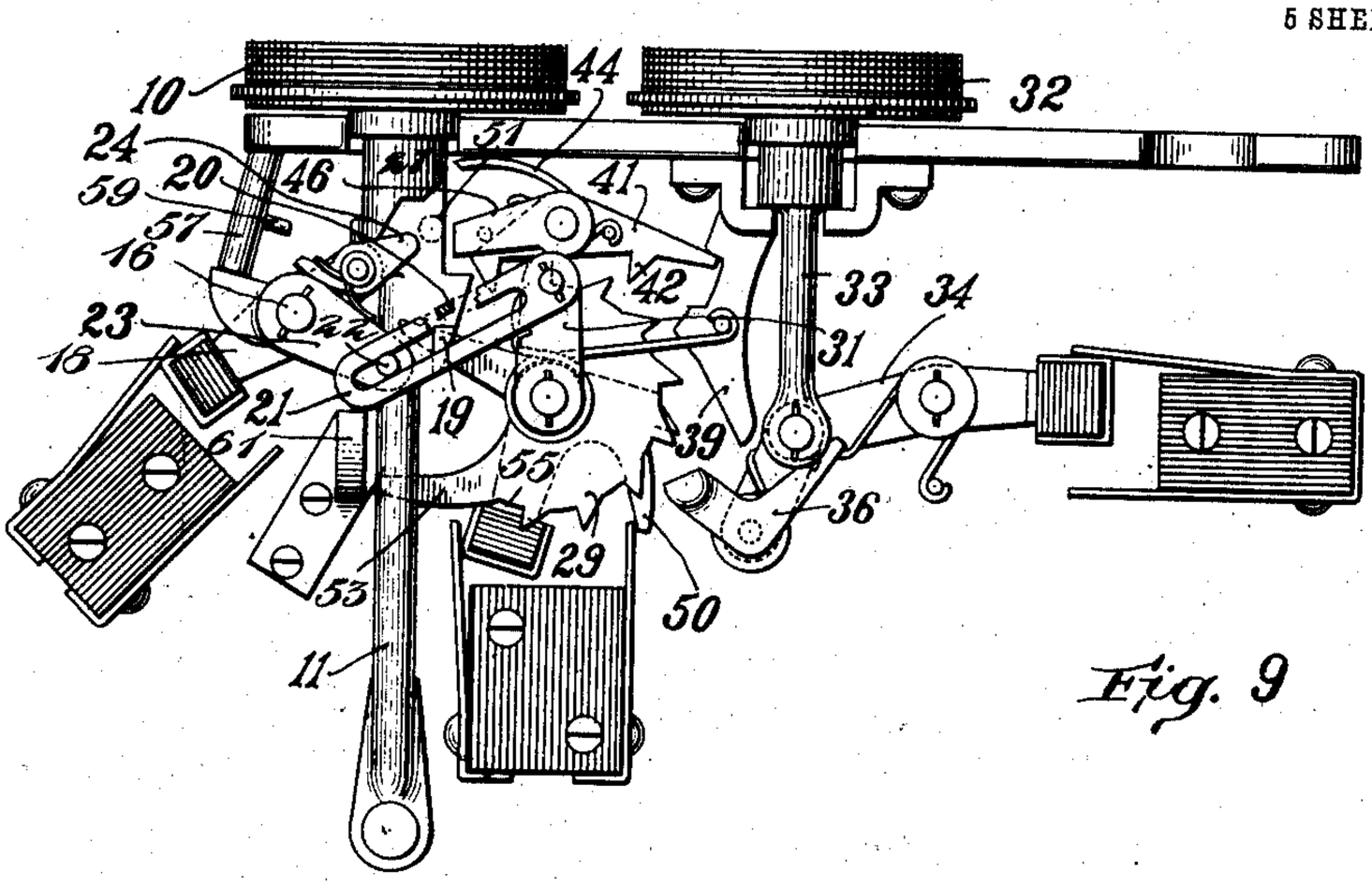

Fig. 9

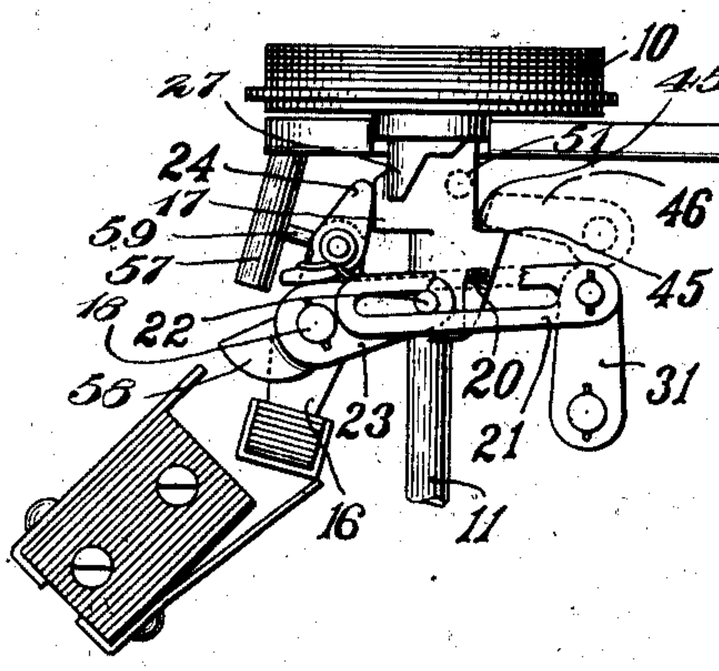

Fig. 10

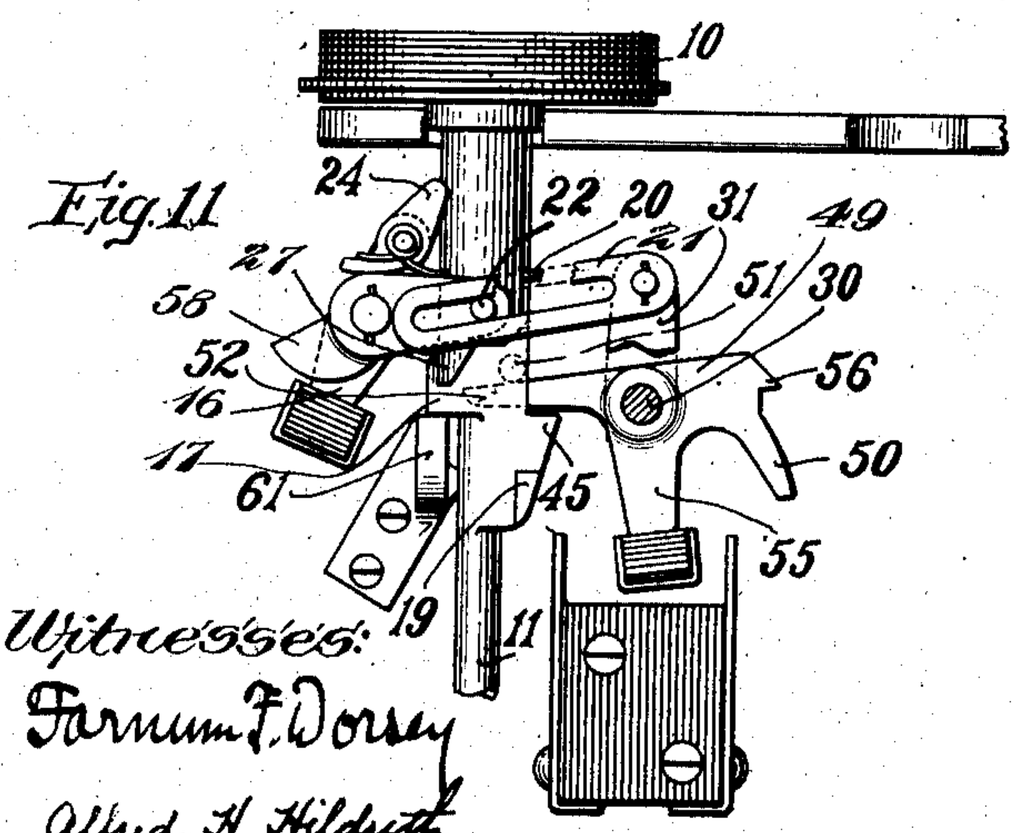

Fig. 11

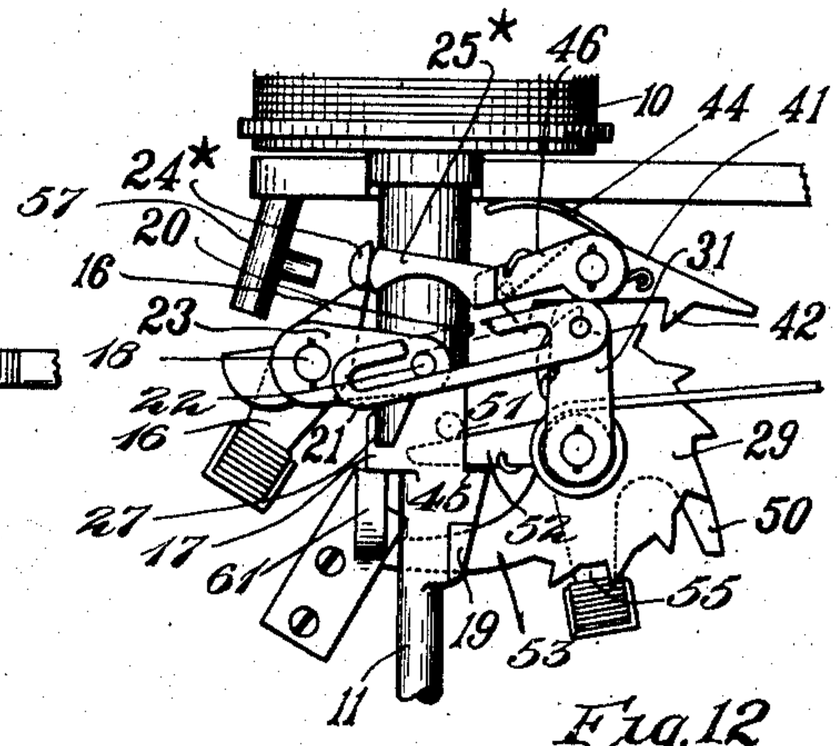

Fig. 12

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5 SHEETS—SHEET 5.

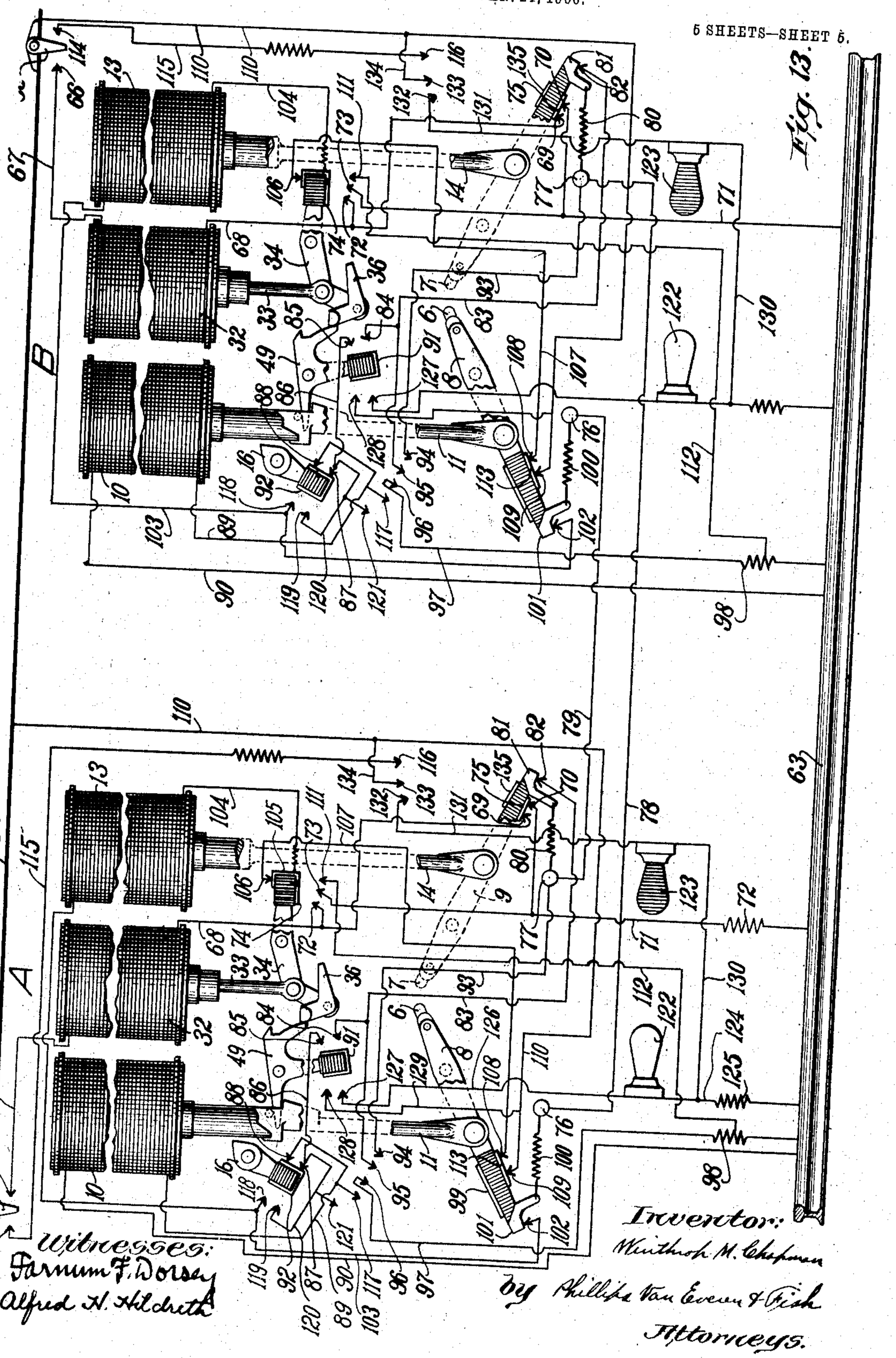

Fig. 13.

UNITED STATES PATENT OFFICE.

WINTHROP M. CHAPMAN, OF NEEDHAM, MASSACHUSETTS.

RAILWAY BLOCK-SIGNAL SYSTEM.

No. 865,013. Specification of Letters Patent. Patented Sept. 3, 1907.

Application filed January 24, 1906. Serial No. 297,557.

To all whom it may concern:

Be it known that I, WINTHROP M. CHAPMAN, a citizen of the United States, residing at Needham, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Railway Block-Signal Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to railway block signal systems and more particularly to electric railway block signal systems suitable for use in connection with electric street railways.

An object of the present invention is to provide an improved signal apparatus, for use in railway block signal systems, which is simple and durable in construction and certain and reliable in operation.

A further object of the invention is to improve the arrangement of circuits and apparatus of railway block signal systems so that the signals under abnormal conditions cannot be improperly actuated and under normal conditions will be actuated with certainty to indicate the presence or absence of cars upon the track sections or blocks of the railway.

With these objects in view the 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.

The invention is intended primarily for use on single track electric street railways. It is to be understood, however, that while the invention is particularly applicable for use on single track roads and is embodied in its preferred form in an apparatus adapted for use on such roads, certain features of the invention are not limited to an apparatus or signal system adapted only for use in connection with single track roads, but may be embodied in other forms of apparatus and systems.

The various features of the present invention will be understood from the following description taken in connection with the drawings accompanying this application, in which

Figure 1 is a view in front elevation of the improved form of signal apparatus; Fig. 2 is a detail view of the lower end of the rod which forms a continuation of the core of one of the signal setting magnets; Fig. 3 is a view similar to Fig. 1, illustrating, on an enlarged scale, the principal portion of the signal apparatus; Fig. 4 is a sectional plan view taken on the line 4—4 of Fig. 3; Fig. 5 is a detail view of a portion of the mechanism shown in Fig. 3 illustrating the position which the parts assume at the beginning of the operation of setting the signal at safety; Fig. 6 is a detail sectional plan view illustrating a portion of the mechanism for actuating the locking lever to allow the signal to return to normal position; Fig. 7 is a view similar to Fig. 5, illustrating the position which the parts assume at another stage in the operation of setting the signal at safety; Fig. 8 is a detail view of a portion of the rod connected to the core of one of the setting magnets, and a portion of the locking lever; Fig. 9 is a view similar to Fig. 5 illustrating the position which the parts assume after the signal has been set at safety; Fig. 10 is a detail view illustrating the position of certain of the parts during the operation of actuating the locking lever to allow the signal to return to its normal position; Fig. 11 is a view similar to Fig. 10, illustrating the position of the parts after the signal has been returned to its normal position, Fig. 12 is a detail view illustrating a somewhat different construction from that illustrated in the other figures for holding the locking lever out of locking position, and Fig. 13 is a diagrammatic view illustrating the arrangement of the apparatus and the circuit connections and contacts for one block of a single track electric street railway.

The signal system illustrated in the drawings as embodying the preferred form of the present invention comprises a signal apparatus at each end of a track section or block, the signal apparatus and their circuit connections being duplicates of each other. Each signal apparatus comprises a signal which is movable from normal to either of two positions, one of the positions to which it is moved indicating danger, and the other position indicating safety. Means are provided whereby when a car enters an empty block from either direction the signal at the entering end of the block is set at safety and the signal at the distant end of the block is set at danger. The apparatus at both ends of the block and the various contacts and circuits are so arranged that after the signals have been set by a car entering the block in one direction they cannot be returned to normal position or actuated in any manner by the entrance of a car on to the block from the opposite direction. Means are provided whereby the signals are returned to normal position when a car passes out of the block, and in order to allow more than one car going in the same direction to be on the block at the same time a controller is provided which is actuated by cars entering and leaving the block, and which prevents the return of the signals to normal position until the last car leaves the block. The apparatus and the contacts and the circuit connections are also so arranged that the controller will be properly actuated in case cars going in the same direction enter and leave the block simultaneously. Provision is also made whereby both signals cannot be set at safety in case cars enter the block simultaneously from opposite directions.

Railway block signal systems in which the signals are arranged and actuated as above described, are disclosed in my prior patents No. 711,037, dated October 14, 1902, and No. 759,346, dated May 10, 1904,

and those features of the present invention which relate to the signal apparatus are embodied in an improved means for actuating the signal, in an improved controller and controller actuating mechanism, in an improved locking device for preventing the return of the armature of one of the signal setting magnets and improved mechanism for actuating said device, in an improved means for indicating an actuation of the controller whenever a car enters the block after the signal at the entering end of the block has been set at safety, and in an improved means to cause the controller to be actuated properly when cars enter and leave the block simultaneously.

In my pending application, Serial No. 141,821, filed February 4, 1903, a railway block signal system is disclosed having the same general mode of operation as the systems disclosed in my prior patents, but in which the signals stand normally at danger and only the signal at the entering end of the block is actuated when cars enter and leave the block. In that railway block signal system the circuits and contacts were so arranged as to prevent the improper actuation of the signals when one or both of the line wires connecting the two apparatus at opposite ends of a track section or block was connected to an extraneous source of current by a cross on the wire.

Those features of the present invention which relate to the arrangements of the apparatus, circuits and contacts whereby the signals cannot be improperly actuated under abnormal conditions but will be actuated with certainty so as to efficiently protect the track section or block under normal conditions, are embodied in an arrangement somewhat similar to that of the system of my pending application, the apparatus, contacts and circuits, however, being arranged to meet the requirements of a system in which each signal is movable from normal to either of two positions instead of being movable from a danger to a safety position. The features of invention which relate to the arrangement of the apparatus, contacts and circuits also include an arrangement by which an improper actuation of a signal is prevented when a line wire is grounded.

Referring now to Figs. 1 to 11 inclusive, in which is illustrated the preferred embodiment of the signaling apparatus, 1 indicates the signal which as illustrated consists of a target one side of which is preferably painted white, and the other side red. This target is secured upon the lower end of a rod 2 mounted to rotate in bearings in the case of a signal box 3 but held from longitudinal movement. The normal position of the target 1 is, as illustrated in Fig. 1, with its edge presented to a car approaching the block. A quarter turn of the rod 2 in one direction causes the white side of the target to be displayed, the target when in this position indicating safety, and a quarter turn of the rod 2 in the opposite direction causes the red side of the target to be displayed, which latter position indicates danger. The rod 2 at its upper end is provided with two inclined or spiral grooves or guideways 4 and 5, which communicate at their upper ends as indicated in Fig. 1. These grooves are engaged respectively by pins 6 and 7 upon the inner ends of pivoted levers 8 and 9. The levers 8 and 9 stand normally in the position indicated in Fig. 1, both pins 6 and 7 being at the upper communicating portion of the grooves. An actuation of the lever 8 causes the pin 6 to traverse the groove 4 and turn the rod 2 through a quarter of a revolution in one direction, while an actuation of the lever 9 causes the pin 7 to traverse the groove 5 and impart a quarter turn to the rod 2 in the opposite direction. In the construction illustrated, the target 1 is turned to its safety position by an actuation of the lever 8 and is turned to its danger position by an actuation of the lever 9. The pins 6 and 7 engage the grooves 4 and 5 in such manner that the target is positively locked at all times against rotation from any external force applied to the target or to the rod 2, as will be apparent from an inspection of Fig. 1. The lever 8 is actuated in one direction by an electro-magnet 10 of the solenoid type, the armature core of which is provided with a downwardly projecting rod 11 secured to or formed integral with the core, and pivotally connected at its lower end to the outer end of the lever 8. A counterbalancing spring 12 is coiled around the pivot of the lever and the lever is returned to its normal position by gravity. The lever 9 is actuated by a solenoid magnet 13 through a rod 14, forming a downward projection from the core of the solenoid and connected at its lower end to the outer end of the lever 9. The lever 9 is returned to its normal position by gravity and is acted upon by a counterbalancing spring 15 coiled around its pivot.

In the operation of the system the magnet 10 of the apparatus at the entering end of the block is energized and the signal at the entering end of the block is set at safety whenever a car enters an empty block, as will be hereinafter described. After the signal at the entering end of the block is set at safety the magnet 10 is deënergized, and in order to prevent the return of the signal to its normal position a locking lever 16 is provided which engages a shoulder 17 on the rod 11 and prevents the return of the rod and armature core to their normal positions. The locking lever 16 is pivoted upon a fixed stud 18 as best shown in Figs. 6 and 8. The shape of that portion of the lever which engages the shoulder 17 is clearly shown in Fig. 8 in which this portion of the lever appears in cross section.

In the apparatus illustrated the magnet 10 is also utilized to return the target 1 to its normal position, the magnet 10 being energized whenever a car leaves the block, as will be hereinafter described, and means being provided whereby the upward movement of the core of the solenoid and the rod 11 connected thereto actuate the locking lever to remove it from beneath the shoulder 17 of the rod. In order to enable the locking lever to be actuated from the magnet 10 it is so arranged that when the magnet is deënergized its core and the rod 11 are allowed to drop a short distance before coming in contact with the locking lever. That is, the upward movement of the core of the magnet and the rod 11, when the magnet is energized, moves the shoulder 17 some distance above the locking lever so that after the signal 1 has been set at safety and the magnet 10 is deënergized, the core of the magnet and the rod 11 drop until they reach a position in which the shoulder 17 engages the locking lever. This movement of the core and rod 11, however, has no effect on the signal, as at this time the pin 6 is traveling in a straight portion of the groove 4. When the magnet 10 is energized after the signal has been set at safety, the core and rod 11

again rise to their highest position and this movement of the core and rod is utilized to actuate the locking lever to move it from engagement with the shoulder 17. The means for actuating the locking lever comprises a locking lever actuator in the form of a projection 19 on the rod 11 which during the upward movement of the rod 11, after the signal has been set at safety, contacts with a projection 20 on a link 21, forming a portion of the controller to be hereinafter described. The link 21 is provided with a slot through which a pin 22 passes which projects from an arm 23 formed integral with the locking lever 16. The engagement of the projection 19 with the projection 20 raises the link 21 and swings the locking lever about its pivot so as to remove it from beneath the shoulder 17 of the rod 11.

It will be evident that unless some means were provided for holding the locking lever out of the path of movement of the shoulder 17 during the descent of the rod the lever would again move into the path of the shoulder. The means illustrated in Figs. 1 to 11 for accomplishing this result comprises a latch or dog 24, pivotally mounted upon the inner end of the locking lever. This dog is provided at its rear end with a projection 25 which bears against the arm 23 and prevents the movement of the dog with relation to the lever in one direction, the dog being free, however, to move in the opposite direction. The projection 25 is normally held yieldingly against the arm 23 by means of a spring 26 coiled around the pivot of the dog. This dog is arranged to bear against the upper portion of the rod 11 or the lower portion of the core of the magnet 10 during the downward movement of the core and rod and hold the locking lever out of the path of the shoulder 17. During the upward movement of the core and rod in setting the signal at safety a shoulder 27 on the upper end of the rod or on the lower end of the core passes above the dog 24 which moves beneath the shoulder and allows the locking lever to move into its locking position. The dog 24 does not pass beneath the shoulder 27 until the shoulder 17 is some distance above the locking lever. The dog remains beneath the shoulder 27 until the locking lever is actuated by the engagement of the projection 19 with the projection 20 on the link 21 and as the link rises, the dog 24 is allowed to yield and springs past the shoulder 27 so as to be in a position to engage the rod 11 or core of the magnet 10 during the downward movement of the rod and core to hold the locking lever out of the path of movement of the shoulder 17. Since the dog 24 which holds the locking lever out of the path of movement of the shoulder 17 is actuated by the upward movement of the rod 11, it is evident that a yielding connection of some kind must be provided to allow the dog to be moved from beneath the shoulder 27. This yielding connection, in the construction illustrated, is provided by yieldingly mounting the dog upon the locking lever. It will be apparent, however, that the same result could be secured by placing the yielding connection at some other point.

In Fig. 12 a somewhat different construction is illustrated for holding the locking lever out of the path of movement of the shoulder 17 during the descent of the rod 11, which construction is preferred to the construction above described for the reason that it does away with the frictional resistance offered to the rod during its downward movement by the pressure of the spring pressed dog 24 against the rod. In the construction illustrated in Fig. 12 a rigid projection 24* is provided on the locking lever in the place of the spring pressed dog 24, and this projection is arranged to be engaged by an arm 25* projecting from the arm 46. As illustrated in the figure, the arrangement of these parts is such that when the rod 11 is in its lowest position with the signal at safety the projection 25* engages the projection 24* on the locking lever and holds the locking lever out of engagement with the rod. During the upward movement of the rod in setting the signal at safety, the actuation of the arm 46 by the shoulder 45 upon the rod raises the projection 25* out of the path of movement of the projection 24* and allows the locking lever to move into locking position. When the rod 11 is again raised to move the locking lever out of locking position the projection 24* raises the projection 25* which movement is permitted by the spring 47 acting on the arm 46 and as the rod reaches its highest position the projection 25* falls into the path of movement of the projection 24* and holds the locking lever out of engagement with the rod while the rod is descending to its lowest position.

The controller by which the return of the signals to normal position is prevented until the last car leaves the block, comprises the link 21 above referred to, and a ratchet wheel 29 pivotally mounted upon a stud 30 and provided with an arm 31 to which one end of the link is pivoted, the arm extending from the hub of the ratchet wheel and being rigidly secured to or formed integral therewith. After the signal at the entering end of the block has been set at safety by the entrance of the first car on to the block the ratchet wheel 29 is moved forward a step each time a car enters the block and is moved back a step each time a car leaves the block. When but one car is on the block the projection 20 on the link 21 is in the path of movement of the projection 19 on the rod 11 as indicated in Fig. 9. When another car enters the block the ratchet wheel is moved forward a step and thereby the projection 20 is moved out of the path of the projection 19 and it will be evident without further description that the projection 20 remains out of the path of movement of the projection 19 until the ratchet wheel is returned to its original position. The forward movements of the ratchet wheel are produced by a magnet 32 the armature of which is connected by a rod 33 to a lever 34 pivoted upon a fixed stud 35. Upon the inner end of the lever 34 is pivotally mounted a pawl 36 which is forced toward the teeth of the ratchet wheel 29 by means of a spring 37. A counterbalancing spring 38 surrounds the pivot 35 of the lever 34 which is restored to its normal position by gravity when the magnet 32 is deënergized. After the signal at the entering end of the block has been set at safety the magnet 32 is energized each time a car enters the block and then deënergized. The pawl 36 is thus actuated to advance the ratchet wheel 29 step by step. During the upward movement of the pawl it engages a fixed guide 39 and is thereby forced positively into engagement with the teeth of the ratchet wheel in case the spring 37 is broken or for any other reason fails to act. The guide 39 is so shaped as to limit the upward movement of the pawl and at the end of the upward movement of the pawl to clamp the

pawl between the guide and the ratchet wheel. An overthrow of the ratchet wheel is thus positively prevented. The ratchet wheel 29 is acted upon by a coiled spring 40 which tends to return it to its normal position, and its return movements are produced by means of an escapement pallet 41 the detents 42 and 43 of which are arranged to alternately engage the teeth of the ratchet wheel when the pallet is oscillated and allow the ratchet wheel to be returned towards its normal position step by step. The pallet 41 is acted upon by a spring 44 which normally acts to hold the detent 43 in engagement with the teeth of the ratchet wheel so as to retain the ratchet wheel in the position in which it is moved by the pawl 36. The pallet 41 is oscillated each time a car leaves the block to allow the ratchet wheel 29 to move backward the distance between two teeth of the ratchet wheel. In the construction illustrated the magnet 10 is utilized to produce an oscillating movement of the pallet, the magnet being energized each time a car leaves the block, as will be hereinafter described. To actuate the pallet a shoulder 45 is provided upon the rod 11 or core of the magnet 10, which during the upward movement of the rod and core engages an arm 46 mounted upon the pivot of the pallet 41. The arm 46 is yieldingly connected to the pallet by means of a spring 47 and is provided with a pin 48 which extends over that end of the pallet which carries the detent 43. In the normal operation of the apparatus the pin 48 is held in engagement with the pallet by the spring 47 so that the pallet is actuated from the arm whenever the arm is engaged by the shoulder 45. The upward movement of the rod 11 and core of the magnet 10 oscillate the pallet in one direction and the spring 44 returns the pallet to its original position during the downward movement of the rod and core.

The purpose of the yielding connection between the arm 46 and the pallet 41 is to allow the controller to be properly actuated when cars enter and leave the block simultaneously. In such case both the magnets 10 and 32 are energized and the pawl 36 is moved upwardly at the same time that the pallet 41 is oscillated. The detent 42 is thus brought into the path of the teeth of the ratchet wheel but is yieldingly held in this position by reason of the yielding connection between the arm 46 and the pallet so that the detent can yield and allow the ratchet wheel to be advanced by the pawl 36.

When the target 1 is in its normal position the various parts of the apparatus are in the positions indicated in Fig. 3, and it will be seen that at this time the projection 20 on the link 21 is in the path of movement of the projection 19 on the rod 11. In order to allow the signal to be set at safety the projection 20 must be moved out of the path of the projection 19. This is accomplished by imparting a forward movement to the ratchet wheel 29 sufficient to remove the projection 20 from the path of the projection 19, but not sufficient to cause the ratchet wheel to be retained in its advanced position by the detent 43. The magnet 32 is energized when the first car enters the block as well as when succeeding cars enter the block. The pawl 36 is thus given its complete upward stroke and actuates the ratchet wheel 29. In order to prevent the ratchet wheel being moved a sufficient distance to cause it to be retained in its advanced position by the detent 42 a lever 49 is pivotally mounted upon the stud 30 and provided with an arm 50 which when the target 1 is in its normal position engages the pawl 36 and prevents it from coming in contact with the tooth of the ratchet wheel which it would otherwise engage during its upward movement. The lever 49 is held in this position when the target 1 is in its normal position by means of a pin 51 on the rod 11, or core of magnet 10, which engages the upper side of the arm 52 of the lever. The ratchet wheel 29 is held in its normal position by the engagement of an arm 53 on the ratchet wheel with a rigid bracket 54, the teeth of the ratchet wheel being in such position that the pawl 36 engages a tooth of the ratchet wheel during its upward movement and advances the ratchet wheel a sufficient distance to remove the projection 20 from the path of the projection 19 on the rod 11. The lever 49 is provided with an arm 55 and with a ratchet tooth 56 which is engaged by the pawl 36 during each of its upward movements so that each time the magnet 32 is energized the lever 49 and its arm 55 are actuated. The purpose of this construction and operation will be hereinafter explained in connection with the description of the operation of the entire system.

The inward movement of the locking lever 16 into a position to engage the shoulder 17 of the rod 11 is limited by a fixed stop 57 which engages a projection 58 on the locking lever. The locking lever is thus prevented from bearing against the rod 11 and interfering with the downward movement of the rod after the magnet 10 has been deënergized. A fixed stop 59 is also provided which is arranged to engage the locking lever and to limit its movement when it is actuated to allow the signal to return to normal position. The movement of the pallet 41 under the force of the spring 44 is limited by a stop shoulder 60 on the guide plate 39 and the downward movement of the rod 11 and core of magnet 10 when the target 1 is returned to its normal position is limited by a fixed stop 61.

In addition to the parts hereinbefore described, each signal apparatus also comprises two signal lamps for use as night signals in place of the target 1, or as day signals in addition to the target, and various resistance coils and contacts, the arrangement of which will be more clearly understood from an inspection of Fig. 13, in which the contacts are indicated diagrammatically. From this figure, taken in connection with the figures illustrating the actual construction of the apparatus, the specific manner in which the contacts are arranged in the apparatus will be apparent without further description.

Referring now to Fig. 13, in which is illustrated the arrangement of the apparatus, circuits and contacts for a single section or block of the track, A indicates the apparatus at one end of the block and B the apparatus at the other end of the block, these apparatus and their circuit connections and contacts being duplicates of each other. 62 indicates the trolley wire of an electric street railway, and 63 a rail or other return circuit. At one end of the block a circuit closer 64 is provided, and at the other end of the block a similar circuit closer 65. These circuit closers may be of any suitable construction, such, for instance, as is disclosed in my prior Patent No. 711,036, dated October 14, 1902, and are arranged to be operated by cars entering or leaving the block in either direction. Referring for convenience

to apparatus A, 66 indicates a contact arranged to be connected to the trolley wire 62 by the circuit closer 64 whenever a car enters the block from the left. This contact is connected by a wire 67 to one terminal of the magnet 32. The other terminal of the magnet 32 is connected by a wire 68 to a contact 69. Adjacent to this contact is a contact 70 which is connected to a wire 71 leading through a resistance 72 to the rail 63. Wires 68 and 71 are connected to contacts 72 and 73 adjacent to each other and arranged to be bridged by a contact plate 74 on the lever 34 whenever the magnet 32 is energized. The contacts 69 and 70 are normally bridged by a contact plate 75 on the lever 9. 76 and 77 indicate binding posts to which the two line wires 78 and 79 are respectively connected. The binding post 77 is connected by a wire 80 to a contact block 81 on the outer end of the lever 9. This block, when the lever 9 is in its normal position, engages a contact 82 which is connected by a wire 83 to a contact 84. Adjacent to the contact 84 is a contact 85 connected by a wire 86 to a contact 87 and adjacent to the contact 87 is a contact 88 which is connected by a wire 89 to one terminal of the magnet 10. The other terminal of the magnet 10 is connected by a wire 90 to the rail 63. The contacts 84 and 85 are arranged to be bridged by contact plate 91 on the arm 55 of the lever 49 whenever the lever is actuated. The contacts 87 and 88 are arranged to be bridged by a contact plate 92 on the outer end of the locking lever when the locking lever is in its normal position. The binding post 77 is also connected by a wire 93 to a contact 94 adjacent to which is a contact 95 connected to the wire 83 and a contact 96 connected to a wire 97 which leads through a resistance 98 to the rail 63. The contacts 94, 95 and 96 are arranged to be bridged by a contact plate 99 on the outer end of the lever 8 when the target 1 is set at safety. The binding post 76 is connected by a wire 100 to contact block 101 on the outer end of the lever 8. When the lever is in its normal position this block engages a contact 102 which is connected by a wire 103 to one terminal of the magnet 13. The other terminal of this magnet is connected by a wire 104 to a contact plate 105 on the outer end of the lever 34. When the lever 34 is in its normal position the contact plate 105 engages a contact 106 connected to a wire 107 which leads to a contact 108. Adjacent to contact 108 is a contact 109 which is connected by a wire 110 to the trolley wire 62. When the lever 34 is actuated the contact plate 105 is brought into engagement with a contact 111 connected to a wire 112 which leads to the resistance 98 in the wire 97. The contacts 108 and 109 are arranged to be bridged by contact plate 113 when the target 1 is in its normal position.

The contacts and circuit connections above described are utilized in setting the signal at the entering end of the block at safety and the signal at the distant end of the block at danger when a car enters the block from either direction. To enable the signals to be returned to their normal positions when a car leaves the block a contact 114 is arranged adjacent to the circuit closer 64 so as to be connected to the trolley 62 by the circuit closer when a car leaves the block. This contact is connected by a wire 115 to a contact 116 which is arranged to be engaged by the contact block 81 when the lever 9 is actuated by the magnet 13, the block remaining in engagement with the contact while the target 1 is at danger. A contact 117 is also provided, connected to the wire 89 and arranged to be engaged by the block 101 on the lever 8 when the lever is actuated by the magnet 10. The block 101 remains in engagement with the contact 117 while the signal remains at its safety position and is not disengaged therefrom until the signal returns to its normal position.

In the signal apparatus hereinbefore described, an actuation of the controller by a car entering a block after the signal at the entering end of the block has been set at safety is indicated by turning the target through a quarter of a revolution to present its edge to the approaching car and then returning it to its safety position. This is accomplished by energizing the magnet 13 which actuates the lever 9 to impart a quarter revolution to the rod 2 supporting the target, the pin 7 during this movement of the lever engaging the groove 4 and rotating the rod 2 in the same direction in which it was rotated by the lever 8 and pin 6 in setting the target at safety. This rotation of the target by the actuation of the lever 9 when the target is in its safety position is permitted by an enlargement of the lower portion of the groove 4. To enable the magnet 13 to be energized when a car enters a block after the signal at the entering end of the block has been set at safety two contacts 118 and 119 are provided which are arranged to be bridged by the contact plate 92 when the locking lever is in its locking position, the contact 118 being connected to the wire 103, and the contact 119 being connected by a wire 120 to the contact 87.

In order to cause the controller to be properly actuated when cars enter and leave the block simultaneously, it is necessary that the rod 11 be held raised until the pawl 36 has descended for some distance and the ratchet wheel 29 returned a sufficient distance to prevent the detent 42 from retaining the ratchet wheel in the position to which it was advanced by the pawl, as otherwise the controller would be moved forward a step, and when the last car left the block the signals would not be returned to their normal position. In the present signal system, the proper actuation of the controller when cars enter and leave the block simultaneously is secured by maintaining the magnet 10 energized until after the magnet 32 has been deënergized. The connections for so energizing the magnet 10 comprise a contact 121 connected to the wire 120 and arranged to engage the contact block 101 when the magnet 10 is energized. The block 101 is brought into engagement with the contact 121 when the lever 8 is moved by the energizing of the magnet 10, the block being out of engagement with the contact while the target 1 is in its safety position and the magnet 10 deenergized.

The signal lamps are indicated at 122 and 123, the lamp 122 being preferably white, and the lamp 123 being red. One terminal of the lamp 122 is connected to the rail 63 by a wire 124 which includes a suitable resistance 125, and the other terminal of the lamp is connected by a wire 126 to a contact 127. Adjacent to this contact is a contact 128 which is connected by a wire 129 to the wire 110. The contacts 127 and 128 are arranged to be bridged by the contact plate 91 when the lever 49 is in the position which it assumes

after the target 1 has been set at safety. One terminal of the lamp 123 is connected by a wire 130 to the wire 124 and the other terminal of the lamp is connected by a wire 131 to a contact 132. A contact 133 is arranged adjacent to the contact 132 and is connected by a wire 134 to the wire 110. These contacts are bridged by a contact plate 135 on the lever 9 when the lever is actuated by the magnet 13.

The operation of the apparatus when cars enter and leave the block is as follows: The block being empty and the various parts of the apparatus being in the positions indicated in Figs. 1, 3 and 13, a car entering the block from the left actuates the circuit closer 64 and thereby closes a circuit including the magnet 32, said circuit comprising the wire 67, magnet 32, wire 68, contact 69, contact plate 75, contact 70, and wire 71. The lever 34 is actuated and the pawl 36 advances the ratchet wheel 29 a sufficient distance to remove the projection 20 from the path of movement of the projection 19 on the rod 11. At the same time the lever 49 is actuated and the contact plate 91 bridges the contacts 84 and 85. The bridging of contacts 84 and 85 closes a circuit from the trolley wire 62 to the rail 63 including the magnet 13 of apparatus B and the magnet 10 of apparatus A as follows: wire 110 of apparatus B, contact 109, contact plate 113, contact 108, wire 107, contact 106, contact plate 105, wire 104, magnet 13, wire 103, contact 102, contact block 101, wire 100, binding post 76 of apparatus B, line wire 79, binding post 77 of apparatus A, wire 80, contact block 81, contact 82, wire 83, contact 84, contact plate 91, contact 85, wire 86, contact 87, contact plate 92, contact 88, wire 89, magnet 10 and wire 90. The energizing of these magnets actuates the lever 8 of apparatus A and the lever 9 of apparatus B, setting the signal at the entering end of the block at safety and the signal at the distant end of the block at danger. The contact plate 99 of the lever 8 bridges contacts 94, 95 and 96 so that a connection is formed from the binding post 77 of apparatus A to the rail 63 which does not include the magnet 10 or the contacts 84-and 85. The magnet 10 is deënergized as soon as the circuit of magnet 32 is opened by the circuit closer 64 and the contact plate 91 disengages the contacts 84 and 85. The magnet 13 of apparatus B, however, remains energized, a circuit for said magnet being completed by the bridging of contacts 94, 95 and 96. As soon as the magnet 32 is deënergized the ratchet wheel 29 returns to its original position and the lever 49 swings so as to bring the contact plate 91 into engagement with the contacts 127 and 128, thereby closing the circuit of the signal lamp 122 and causing the lighting of the lamp. The signal at the entering end of the block being at safety and the signal at the distant end of the block being at danger, if another car enters the block before the first car leaves the block the magnet 32 of apparatus A is again energized. At this time the arm 50 of the lever 49 is out of engagement with the pawl 36 so that the pawl advances the ratchet wheel 29 a step, the ratchet wheel being retained in its advanced position by the detent 43. The lever 49 is actuated in the same manner as when the first car entered the block, and the contact plate 91 is moved from contacts 127 and 128 to contacts 84 and 85. This breaks the circuit of the signal lamp, thereby extinguishing the lamp, and at the same time closes a circuit from the binding post 77 through the magnet 13 of apparatus A to the rail 63, which circuit includes the wire 93, contact 94, contact plate 99, contact 95, contact 84, contact plate 91, contact 85, wire 86, contact 87, wire 120, contacts 119 and 118, which are now bridged by the contact plate 92, wire 103, magnet 13, wire 104, contact plate 105, contact 111, with which the contact plate 105 is now in engagement, wire 112, and resistance 98. The energizing of magnet 13 causes the actuation of the lever 9 and the turning of the target from safety to an edge-on position. The target remains in this position until the magnet 32 is deënergized by the opening of circuit closer 64. The deënergizing of magnet 32 breaks the circuit of magnet 13 at the contacts 84 and 85 and at the contact 111 so that the core of the magnet drops and the target is returned to its safety position. Each time, therefore, that a car enters the block and causes an actuation of the controller the target is moved to indicate such actuation. Also, the white light is momentarily extinguished and the red light is momentarily lighted, the circuit of the red light being completed by the engagement of contacts 132 and 133, by the contact plate 135 on the lever 9. When the number of cars for which the controller is constructed are upon the block the arm 53 of the ratchet wheel 29 is in engagement with the pawl 36 and holds the pawl out of engagement with the tooth 56 of the lever 49 so that the entrance of another car on the block does not cause an actuation of the controller or of the lever 49.

When the first car to enter the block leaves the block the circuit closer 65 is actuated to connect the wire 115 of apparatus B to the trolley wire 62. This closes a circuit through the magnet 10 of apparatus A as follows: wire 115 of apparatus B, contact 116, contact block 81, which is in engagement with contact 116, wire 80, binding post 77 of apparatus B, line wire 78, binding post 76 of apparatus A, wire 100, contact block 101, contact 117, wire 89; magnet 10 and wire 90. The energizing of magnet 10 causes its core and rod 11 to be raised and the shoulder 45 of the rod to actuate the escapement pallet. If there is an another car upon the block the locking lever 16 of apparatus A is not actuated as the projection 20 is out of the path of movement of projection 19 on the rod 11. When the last car leaves the block, however, the projection 20 is in the path of movement of projection 19 and the locking lever is actuated as has been hereinbefore described. The actuation of the locking lever allows the core of magnet 10 and rod 11 to drop to their lowest position and return the signal of apparatus A to its normal position. The movement of the lever 8 breaks the circuit through which the magnet 13 of apparatus B was energized so that the core of this magnet drops and the signal of apparatus B is returned to normal position.

The operation when cars pass through the block in opposite directions, that is, from right to left, will be obvious without further description.

It will be noted that after the signals are set the contact block 101 on lever 8 is brought into engagement with contact 121 each time a car leaves the block. If a car enters the block at the same instant that a car is leaving the block the contact block 101 is brought into engagement with the contact 121 and at the same time contacts 84 and 85 are bridged by the contact plate 91,

and contact plate 105 is brought into engagement with contact 111. This closes a circuit through the magnet 10 from the binding post 77 of apparatus A to the rail 63, said circuit comprising wire 93, contact 94, contact plate 99, contact 95, wire 83, contact 84, contact plate 91, contact 85, wire 86, contact 87, wire 120, contact 121, contact block 101, contact 117, wire 89, magnet 10 and wire 90. The magnet 10 thus remains energized if the circuit closer 65 opens before the circuit closer 64 as the circuit for the magnet 10 from the binding post 77 to the rail 63 through the contacts 84 and 85 is not broken until after the circuit closer 64 opens. The pawl 36 is thus caused to return towards its lowest position before the rod 11 and core of magnet 10 drop so that when cars enter and leave the block simultaneously the ratchet wheel 29 is first advanced a step and then returned a step towards its normal position.

As has been described, each time a car leaves the block the contact block 101 is brought into engagement with the contact 121, thereby bridging contacts 121 and 117. In order to prevent the magnets 10 and 13 from being permanently energized by the bridging of these contacts, the contacts 108 and 109 are provided which are disengaged at all times except when the target 1 is in its normal position. A break is thus provided in the circuit through which the magnets 10 and 13 would otherwise be permanently energized, said circuit consisting of the wire 110, contacts 109 and 108, wire 107, contact 106, contact block 105, wire 104, magnet 13, wire 103, contact 118, contact plate 92, contact 119, wire 120 contact 121, contact block 101, contact 117, wire 89, magnet 10 and wire 90.

The contact 106 which, when the apparatus is in normal position, is engaged by contact plate 105, is provided to form a break in the circuit through which the signal at the distant end of the block is set at safety, in order to prevent the setting of both signals when cars enter the block simultaneously from opposite directions.

The contacts 69 and 70, which are bridged by the contact plate 75 on the lever 9, are provided in order to prevent the improper actuation of the signals in case there is a ground on one of the line wires. Thus, if there is a ground on the line wire 79, for instance, the ground allows the current to flow through the magnet 13 of apparatus B so that the magnet is energized and the core of the magnet is raised. This removes the contact plate 75 from the contacts 69 and 70 and breaks the circuit of magnet 32 of apparatus B so that in case a car enters the block from the right the magnet 32 is not energized and the signal of apparatus B remains in its danger position.

The contacts 72 and 73, which are bridged by the contact plate 74, when magnet 32 is energized, are provided to keep the circuit of magnet 32 closed after the magnet 13 is energized when a car enters the block.

It will be apparent from the foregoing description that when cars enter the block from the left the line wire 79 is utilized in setting the signals and the line wire 78 is utilized in restoring the signals to normal condition, and when cars enter the block from the right the functions of the line wires are reversed, the line wire 78 being utilized in setting the signals and the line wire 79 in restoring them to normal condition. It will also be apparent that the circuit through which a current is transmitted to set the signal at one end of the block at safety is broken when the signal at the other end of the block is set at safety, the break in the setting circuit being caused by the separation of the block 101 from the contact 102. A second break is also formed in the setting circuit by the separation of contact plate 113 from the contacts 108 and 109. The signal at either end of the block can therefore be set at safety only when the signal at the other end of the block is in its normal position.

Whenever the magnet 13 is energized the block 81 is removed from contact 82 and brought into engagement with contact 116. At apparatus A this movement of the block 81 connects the line wire 79 to the contact 114 adjacent to circuit closer 64, and at apparatus B connects the line wire 78 to the contact 114 adjacent to circuit closer 65. At the distant end of the block this movement of the block 81 is utilized to connect one of the line wires to a contact 114 so that the line wire can be utilized in restoring the signals to normal condition. At the entering end of the block this movement of the block 81 is utilized to prevent the setting of the signal at the entering end of the block at safety when the line wire which is utilized in returning the signal at the entering end of the block to its normal position is connected to an extraneous source of current. Thus, if there is a source of current upon the line wire 78, when a car enters the block from the left a current is transmitted from the binding post 76 through the magnet 13 to the contact plate 105 as soon as the contact plate strikes the contact 111, and thence through the wire 112 to the rail 63. The magnet 13 thus is energized and the contact block 81 is separated from the contact 82 thereby breaking the circuit through which the magnet 10 of apparatus A is energized and preventing the setting of the signal of apparatus A at safety. If the setting circuits were not broken the signal of apparatus A would be set at safety when a car entered the block and the magnet 10 would be kept permanently energized, the current passing from the binding post 76 to the block 101, and from the block to contact 117, and thence through the magnet 10 to the rail 63.

Contacts 94 and 95 are provided to form a shunt around the contact 82 when the signal is set at safety. The breaking of the circuit at contact 82 is thus prevented when a car enters the block after the signal has been set at safety and the magnet 13 is energized to move the signal target to an edge-on position.

The signal system and signal apparatus above described embodies the various features of the present invention in their preferred form, but it is to be understood that except as defined in the claims the invention is not limited to these specific constructions and arrangements, but may be otherwise embodied.

The invention having been thus described, what is claimed is:—

1. A railway block signal system, having, in combination, a movable signal, signal setting and restoring means, a controller to prevent the restoration of the signal until the last car leaves the block, and means for moving the signal to indicate an actuation of the controller when a car enters the block.

2. A railway block signal system, having, in combination, a signal, signal setting and restoring means, a controller to prevent the restoration of the signal until the last car leaves the block, means for actuating said controller comprising two magnets, means for closing the

circuit of one magnet when a car enters the block, means for closing the circuit of the other magnet when a car leaves the block, and means for maintaining said last mentioned magnet energized until the first mentioned magnet is deënergized when cars enter and leave the block simultaneously.

3. A railway block signal system, having, in combination, a signal, signal setting and restoring means, a controller for preventing the restoration of the signal until the last car leaves the block comprising a ratchet wheel, a pawl and means for actuating the pawl to advance the ratchet wheel step by step, a spring for returning the ratchet wheel, a pivoted escapement pallet provided with a detent on each side of its pivot to engage the ratchet wheel, a spring for oscillating the pallet in one direction, a magnet, an armature therefor, and connections between the armature and pallet for oscillating the pallet in the opposite direction.

4. A railway block signal system, having, in combination, a signal, signal setting and restoring means, a controller for preventing the restoration of the signal until the last car leaves the block, comprising a ratchet wheel, a pawl, and means for actuating the pawl to advance the ratchet wheel step by step, a spring for returning the ratchet wheel, an escapement pallet, a spring for oscillating the pallet in one direction, a magnet, an armature therefor, and connections between the armature and pallet for oscillating the pallet in the opposite direction, and connections comprising a spring arranged to allow the pallet to yield in case the pawl is actuated during the oscillation of the pallet by the armature.

5. A railway block signal system, having, in combination, a signal, signal setting and restoring means, a controller for preventing the restoration of the signal until the last car leaves the block, comprising a ratchet wheel, a pawl, and means for actuating the pawl to advance the ratchet wheel step by step, a spring for returning the ratchet wheel, an escapement pallet, a spring for oscillating the pallet in one direction, a magnet, an aramature therefor, an arm yieldingly connected to the pallet and a projection movable with the armature and arranged to engage the arm and oscillate the pallet in the opposite direction.

6. A railway block signal system, having, in combination, a signal, a magnet, an armature therefor acting when attracted to set the signal, a locking device for preventing the return of the signal to normal position, an actuator for said locking device moved by the armature, mechanism connected with the locking device and arranged to be engaged by said actuator upon a subsequent attraction of the armature, and means for moving said mechanism out of the path of the actuator to allow the locking device to move into locking position when the armature is attracted to set the signal.

7. A railway block signal system, having, in combination, a signal, a locking device for preventing the return of the signal to normal position, a magnet, an armature therefor acting when attracted to set the signal, an actuator for said locking device moved by the armature, a controller comprising mechanism connected with the locking device and arranged to be engaged by said actuator upon a subsequent attraction of the armature, means for actuating the controller to move said mechanism away from the path of the actuator when a car enters the block after the signal has been set, means for energizing said magnet when a car leaves the block, and means operated by the armature for actuating the controller to return said mechanism into the path of the actuator.

8. A railway block signal system, having, in combination, a signal movable from normal to either of two positions, two magnets, armatures for said magnets, and connections between the armatures and the signal arranged to lock the signal in each of its positions acting to move the signal to one position when the signal is in normal position and one magnet is energized, and to move the signal to the other position when the signal is in normal position and the other magnet is energized.

9. A railway block signal system, having, in combination, a target rotatable in opposite directions from normal position to display either side, two magnets, armatures therefor, and connections between the armatures and target acting to rotate the target in one direction when the target is in normal position and one magnet is energized, and to rotate the target in the opposite direction when the target is in normal position and the other magnet is energized.

10. A railway block signal system, having, in combination, a target movable from normal to either of two positions, a rod for actuating the target, two magnets, armatures therefor, connections between the armatures and the rod comprising coöperating pins and grooves constructed to rotate the rod in one direction to move the target from normal to one position when one magnet is energized and to rotate the rod in the other direction to move the target from normal to the other position when the other magnet is energized.

11. A railway block signal system, having, in combination, a target rotatable in opposite directions from a normal edge on position, two magnets, armatures therefor, and connections between the armatures and the target, one magnet acting through said connections to rotate the target in one direction from normal to a safety position and the other magnet acting through said connections to rotate the target in the same direction from safety to an edge on position and to rotate the target in the opposite direction from normal to a danger position.

12. A railway block signal system, having, in combination, a magnet, an armature therefor, a signal actuated by the armature, a locking device for preventing the return of the armature to normal position after having been attracted to set the signal means for actuating the locking device upon a subsequent attraction of the armature to release the armature, means for holding the locking device out of locking position during the return of the armature and means for actuating said holding means to release the locking device when the armature is attracted to set the signal.

13. A railway block signal system, having, in combination, a signal at each end of a track section or block movable from normal to a safety or a danger position, two magnets for actuating each signal, armatures for said magnets, connections between the rmatures and the signal, acting to move the signal from normal to safety position when one magnet is energized and to move the signal from normal to danger position when the other magnet is energized, and means for energizing a magnet at each end of the block to move the signal at the entering end of the block to safety and the signal at the distant end of the block to danger when a car enters an empty block in either direction.

14. A railway block signal system, having, in combination, a signal at each end of a track section or block movable from normal to a safety or a danger position, two magnets for actuating each signal, armatures for said magnets, connections between the armatures and the signal acting to move the signal to safety position when one magnet is energized and to move the signal to danger position when the other magnet is energized, two line wires, means for closing a circuit when a car enters an empty block in either direction, including one of said line wires and the magnets at each end of the block by which the signal at the entering end of the block is moved to safety and the signal at the distant end of the block is moved to danger, said circuit including one line wire when cars enter the block in one direction and including the other line wire when cars enter the block in the opposite direction, means for closing a circuit including the other line wire and said magnet at the entering end of the block when a car leaves the block and means actuated by said magnet for restoring the signals to normal position.

15. A railway block signal system, having, in combination, a signal at each end of a track section or block movable from normal to a safety or a danger position, two magnets for actuating each signal, armature for said magnets, connections between the armatures and the signal acting to move the signal to safety position when one magnet is energized and to move the signal to danger position when the other magnet is energized, two line wires, means for closing a circuit when a car enters an empty block in either direction including one of said line wires

and the magnets at each end of the block by which the signal at the entering end of the block is moved to safety and the signal at the distant end of the block is moved to danger, said circuit including one line wire when cars enter the block in one direction and including the other line wire when cars enter the block in the opposite direction, means for closing a circuit including the other line wire to restore the signals to normal position when a car leaves the block, means for closing a circuit when said last mentioned line wire is connected to a source of current including the magnet at the entering end of the block by which the signal at that end of the block is moved to danger, and means actuated by said magnet when energized by said source of current for preventing the closure of the circuit including the magnet by which the signal is moved to safety.

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

WINTHROP M. CHAPMAN.

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