No. 859,872. PATENTED JULY 9, 1907.

W. M. CHAPMAN.

RAILWAY BLOCK SIGNAL SYSTEM.

APPLICATION FILED FEB. 4, 1903.

4 SHEETS—SHEET 1.

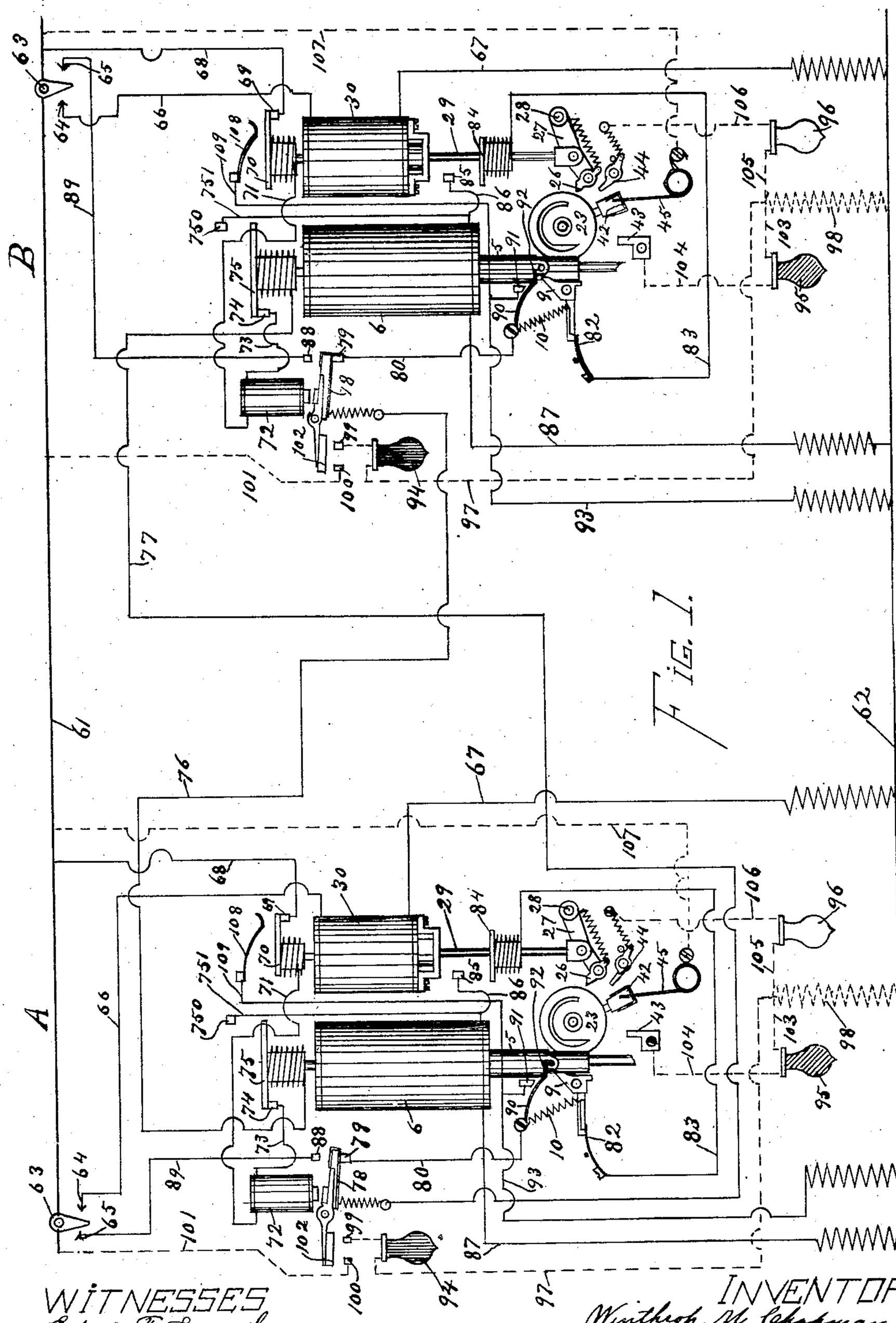

FIG. 1.

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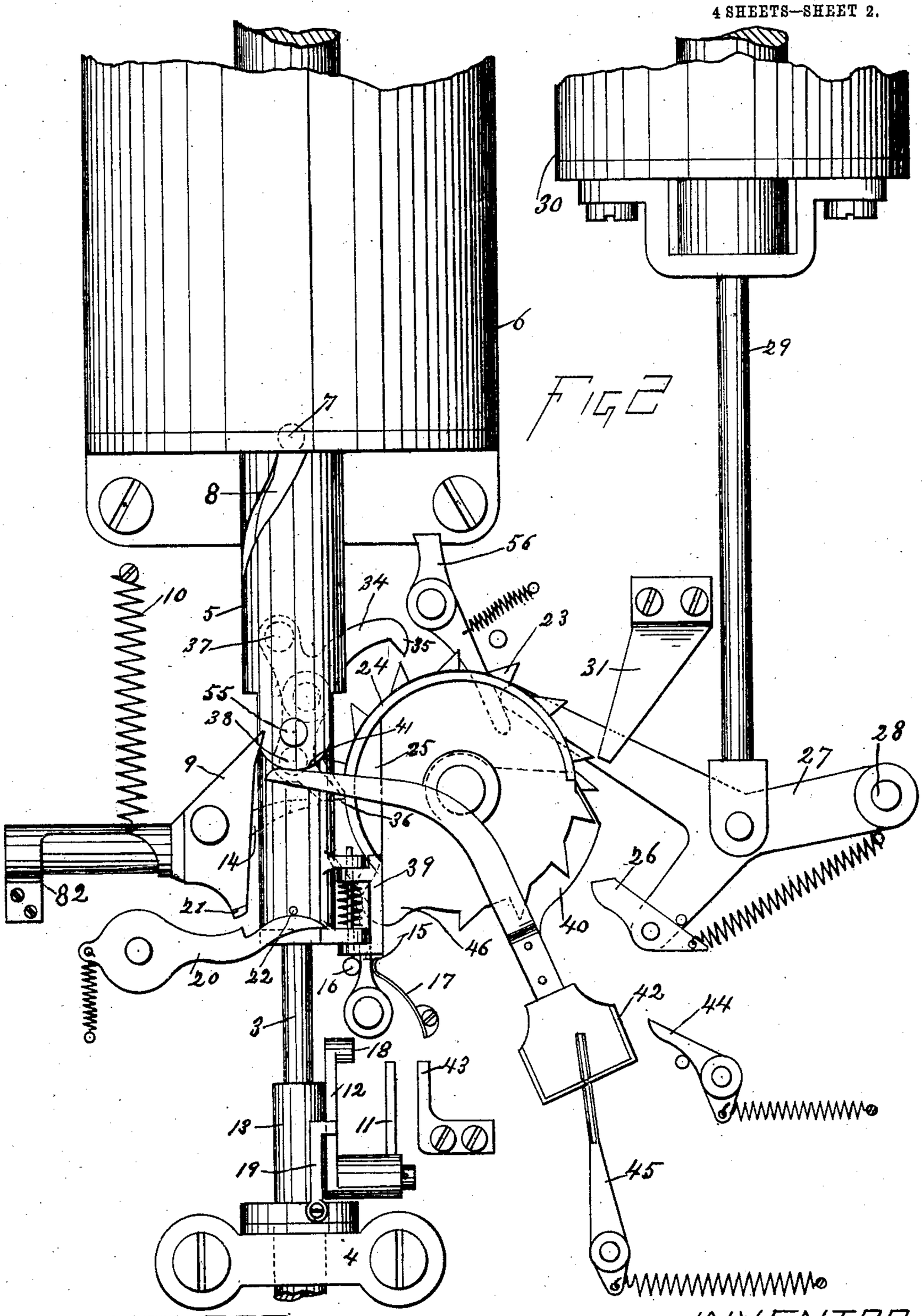

FIG 2

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4 SHEETS—SHEET 3.

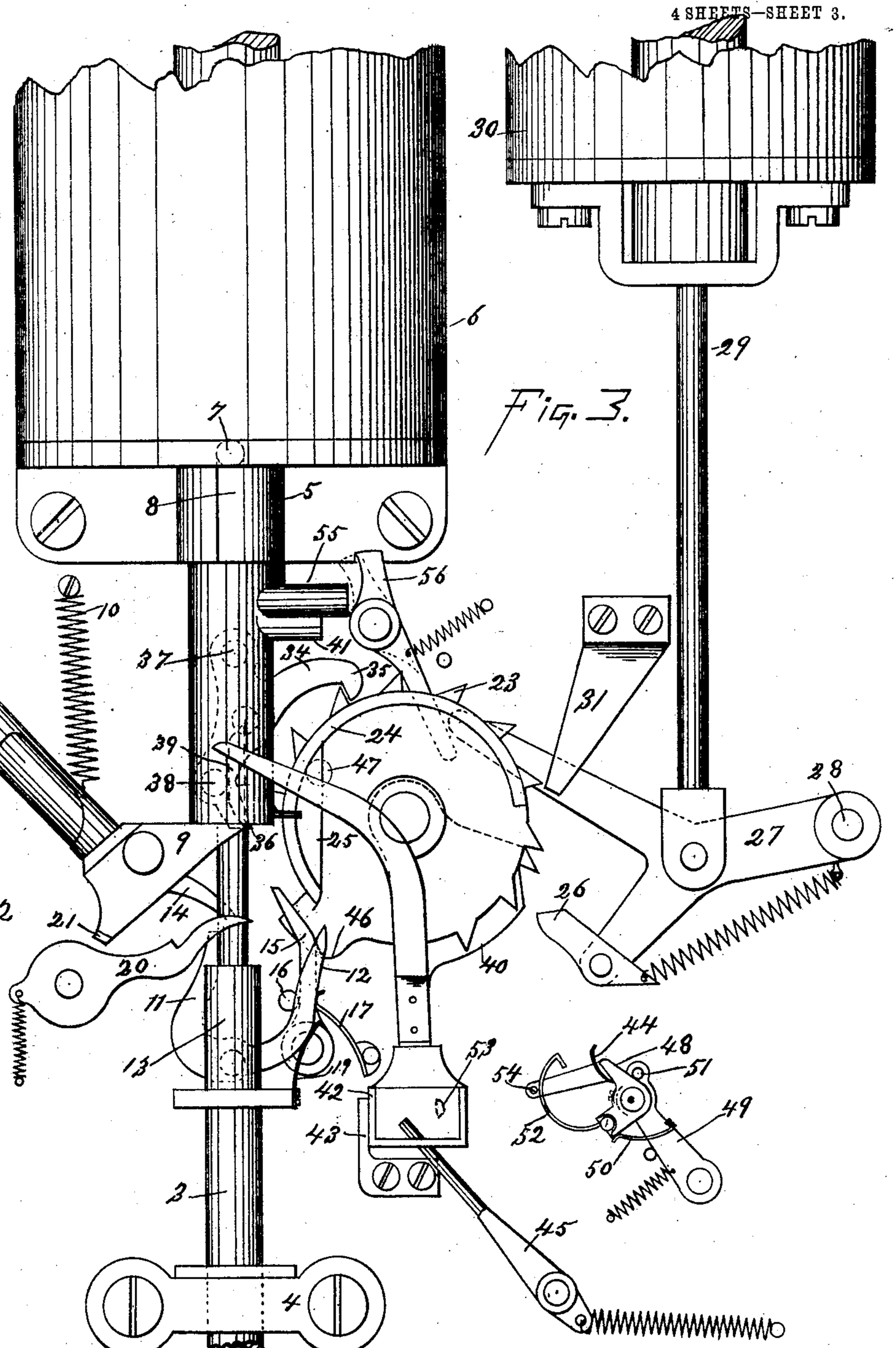

Fig. 3.

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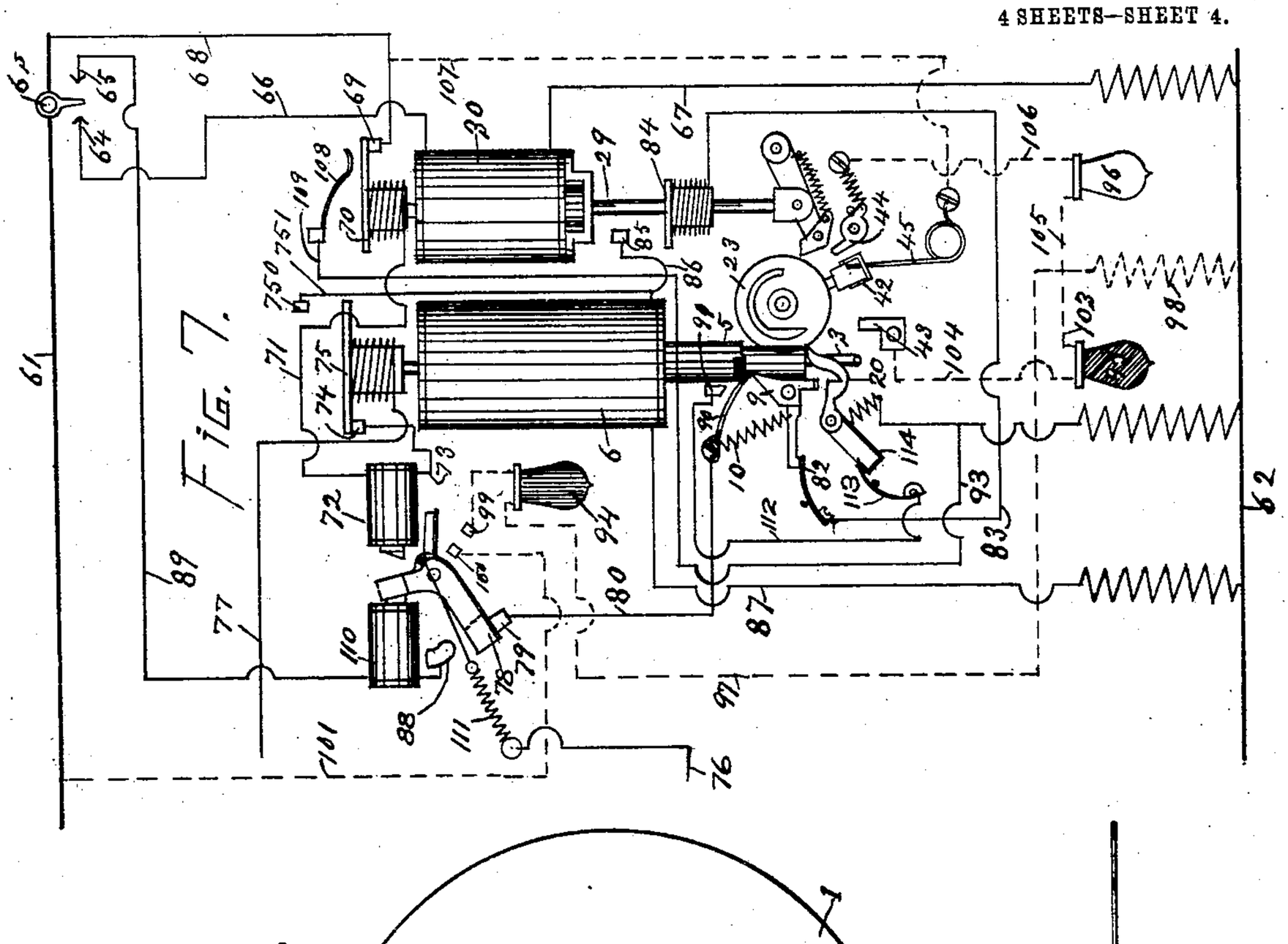

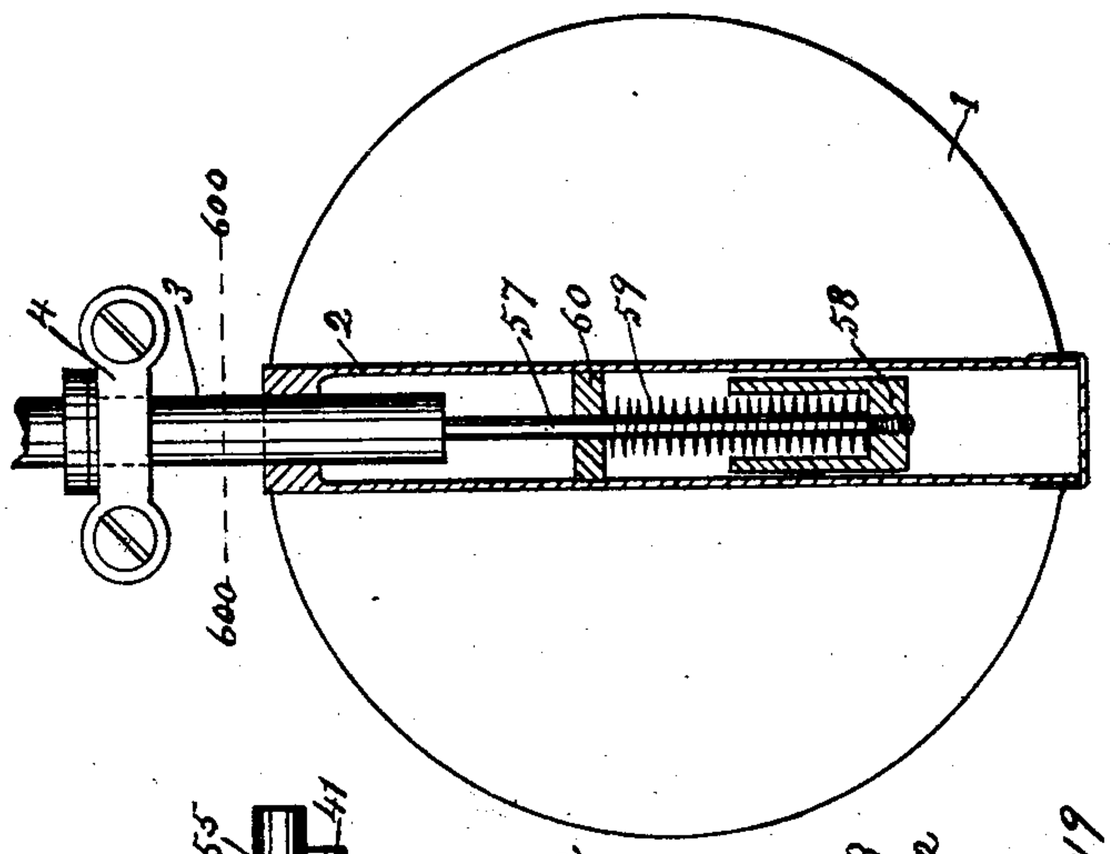

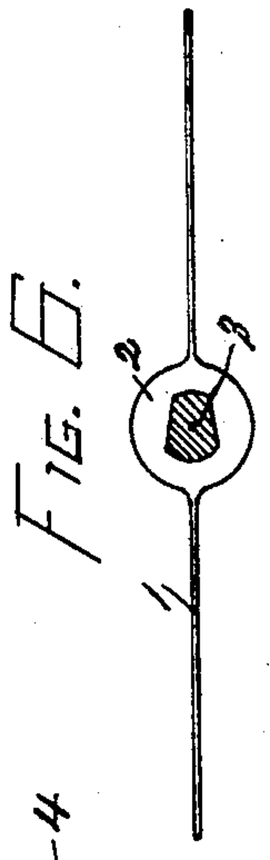

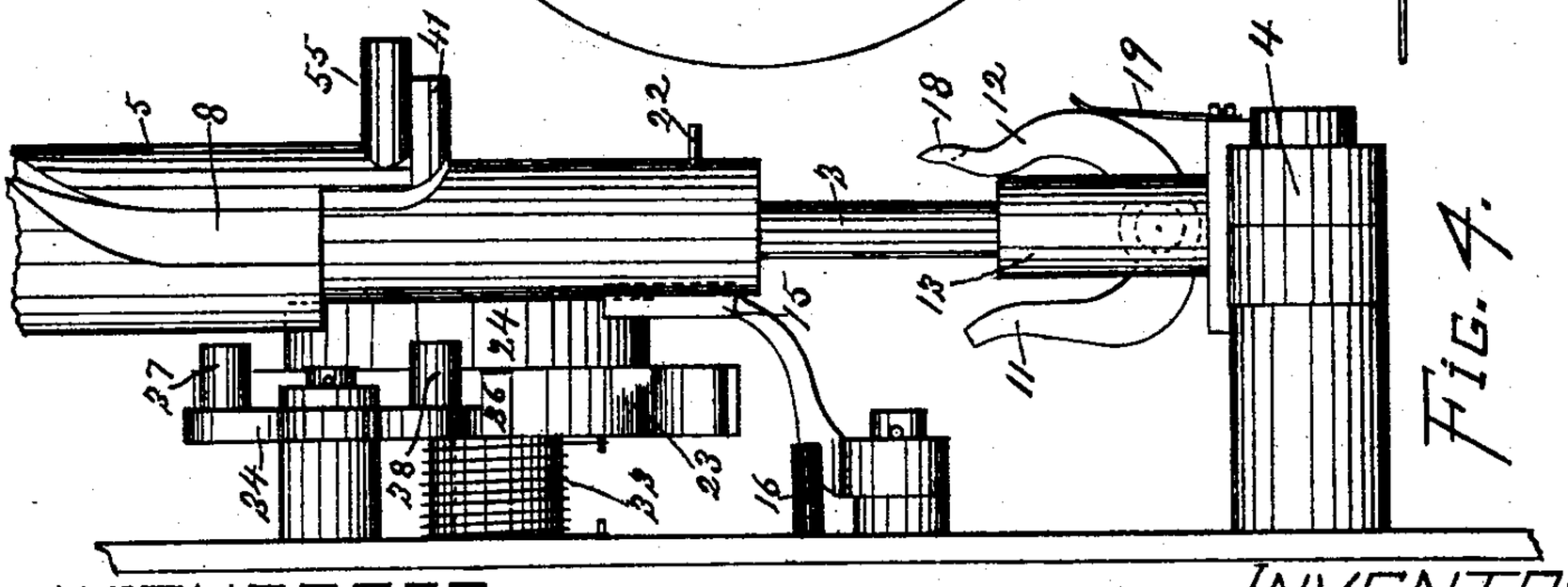

WITNESSES

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UNITED STATES PATENT OFFICE.

WINTHROP M. CHAPMAN, OF NEWTON, MASSACHUSETTS, ASSIGNOR TO ELECTRIC-RAILWAY SIGNAL COMPANY, OF KITTERY, MAINE, A CORPORATION OF MAINE.

RAILWAY BLOCK-SIGNAL SYSTEM.

No. 859,872. Specification of Letters Patent. Patented July 9, 1907.

Application filed February 4, 1903. Serial No. 141,821.

To all whom it may concern:

Be it known that I, WINTHROP M. CHAPMAN, a citizen of the United States, residing at Newton, in the county of Middlesex 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.

The objects of the invention are to simplify and improve the construction, arrangement and mode of operation of the various parts and connections of railway block signal systems with a view to providing a system in which the signals will be properly actuated to indicate the presence or absence of cars upon the track sections or blocks of the railway, in which the danger of the signals being improperly actuated is reduced to a minimum and in which the various conditions met with in actual practice are provided for.

With these objects in view the invention consists in certain constructions and arrangements of connections by which the signals are actuated and also in certain devices, combinations, and arrangements of parts tending to improve and simplify the construction and mode of operation of the signal apparatus.

The invention is intended primarily as an improvement upon the signal systems and signal apparatus disclosed in my prior patent No. 711,037, dated Oct. 14, 1902, and in my pending application Ser. No. 106,944, filed May 12, 1902, and like the signal systems and apparatus disclosed in said patent and pending application is designed for use on single track electric street railways. It is to be understood, however, that certain features of my invention are not limited to signaling systems of the same general character as those disclosed in my prior patent and pending application nor are certain features of my invention limited to use in connection with single track electric street railways.

The various features of my 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 illustrating diagrammatically the circuit connections for one block of an electric block signal system embodying the same, and also illustrating somewhat diagrammatically the construction and arrangement of the various parts of my improved signal apparatus; Fig. 2 is a view illustrating the construction of the signal apparatus indicated in Fig. 1, the various parts being shown in the position which they assume when the signal is in its normal position at danger. Fig. 3 is a view similar to Fig. 2 illustrating the positions which the various parts of the signal apparatus assume after the signal has been set at safety; Fig. 4 is a detail view of a portion of the apparatus illustrated in Fig. 2 looking from the left of the figure; Fig. 5 is a detail view partly in section illustrating the construction by which the signal target is mounted upon its actuating rod; Fig. 6 is a detail sectional plan view taken on the line 600—600 Fig. 5; and Fig. 7 is a diagrammatic view illustrating the circuit connections and apparatus at one end of a track section or block of a signal system embodying a modified form of my invention.

The signal system illustrated in the drawings 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 normally set at danger, one signal when in normal position protecting the block for cars going in one direction and the other signal when in normal position protecting the block for cars going in the opposite direction. When a car approaches the block from either direction, both signals being in their normal position at danger, the signal at the entering end of the block is set at safety. Neither signal can be set at safety when a car approaches the block from either direction unless the other signal is in its normal position at danger, so that the setting of the signal at the entering end of the block at safety serves as an indication that the block is properly protected by the danger signal at the distant end of the block. Also the setting of the signal at the entering end of the block by the entrance of a car onto the block prevents the signal at the distant end of the block being set at safety when a car approaches the block in the opposite direction. The signal at the entering end of the block is restored to normal position when the last car on the block leaves the block. A single magnet is utilized both in setting and in restoring the signal, the circuit connections being so arranged that the magnet of the signal at the entering end of the block is energized to set the signal at safety when a car enters the block and is again energized to restore the signal to its normal position at danger when the last car leaves the block. The system is designed to allow a number of cars to be on the block at the same time and to this end a controller of the same general character as those disclosed in my prior patent and pending application is provided which is actuated when cars enter and leave the block and which prevents the restoration of the signal at the entering end of the block to its normal position at danger until the last car leaves the block.

From the general description given above it will be

seen that the mode of operation of the system illustrated in the drawings is in general the same as that of the systems disclosed in my prior patent and pending application with the exception that the signals normally stand at danger and that only the signal at the entering end of the block is actuated when cars enter and leave the block. The novel features of the system illustrated in the drawings relate to the construction and arrangement of the various parts and circuit connections by which the signals are properly actuated under the various conditions met with in practice and to the construction and arrangement of the various parts of the signaling apparatus. These novel features and their advantages will be readily understood by those skilled in the art from an inspection of the drawings taken in connection with the following specific description thereof.

Referring to Fig. 1, A indicates the signaling apparatus at one end of a track section or block and B a similar apparatus at the other end of the block. The specific construction of these apparatus is clearly illustrated in Figs. 2, 3, 4, 5 and 6. Referring to these figures 1 indicates a signal which as shown is a target provided with a vertical hub 2 mounted upon the lower end of a rod 3 so as to rotate therewith. One face of this target is preferably painted red, and when the signal is in the position of danger this face of the target is presented to a car approaching the block. The safety position of the target is with its edge presented to an approaching car and in order to bring it into this position the rod 3 is turned through a quarter of a revolution. The rod 3 extends through a fixed bearing 4 and is rigidly connected to or formed integral with the core 5 of an electro-magnet 6 of the solenoid type. When the targets 1 of both apparatus A and B are in their normal position at danger and a car enters the block the magnet 6 of the apparatus at the entering end of the block is energized as will be hereinafter described. The energizing of the magnet 6 draws up the core 5 and the rod 3, and during such upward movement the rod and core are turned through a quarter of a revolution by the engagement of a fixed pin 7 projecting into a spiral groove 8 formed in the core. The core and rod are prevented from returning to normal position so as to return the target 1 to a position of danger by means of a locking lever 9, which is pressed against the enlarged upper portion of the rod 3, by means of a coiled spring 10, and which after the core and rod have been raised, swings beneath the shoulder at the lower end of the enlarged portion of the rod. After the signal at the entering end of the block has been set at safety the magnet 6 is energized each time a car leaves the block by means hereinafter described thereby producing an upward movement of the core 5 and rod 3. This upward movement of the core is utilized in restoring the signal to its normal position at danger. To this end a locking lever actuator provided with two upwardly extending arms 11 and 12 is pivotally mounted upon a collar 13 secured to or formed integral with the rod 3 which collar by contacting with the bearing 4 limits the downward movement of the rod and core.

The locking lever 9 is provided with an arm 14 the free end of which is offset to bring it into the path of movement of the arm 11. A guide 15 is pivotally mounted upon the casing of the apparatus and is pressed against a fixed stop 16 by means of a leaf spring 17. The arm 12 of the locking lever actuator is provided with an offset 18 at its free upper end which during the upward movement of the core 5 and rod 3 in setting the signal at safety, passes inside of the guide 15, that is to the left of the guide as viewed in Figs. 2 and 3, the arm 11 of the locking lever actuator being held in a position in which it will not contact with the arm 14 of the locking lever by means of a spring 19 which holds the locking lever actuator in the position indicated in Fig. 4. During the upward movement of the core 5 and rod 3 the offset 18 passes above the upper end of the guide 15 which is pressed backwardly by the engagement of the offset therewith and immediately returned into the path of the offset so that during the downward movement of the core and rod to locking position the offset 18 engages the outer surface of the guide 15 and thereby swings the locking lever actuator against the tension of the spring 19. During the subsequent upward movements of the core 5 and rod 3 the offset 18 is engaged by guide 15 and by a controller to be described and as the last car leaves the block the arm of the locking lever actuator is brought into engagement with the arm 14 and moves the locking lever out of the path of movement of the shoulder at the lower end of the enlarged portion of the rod 3. During the downward movement of the core and rod to return the signal to its normal position at danger the locking lever is held out of the path of movement of the shoulder at the lower end of the enlarged portion of the rod by means of a spring pressed latch 20 which engages a projection 21 on the lever. When the signal has been restored to its position at danger the latch 20 is actuated to release the locking lever by means of a pin 22 on the core which engages the end of the latch. The arm of the locking lever 9 which engages the lower end of the enlarged portion of the rod 3 extends upwardly from the pivot of the lever and is provided at its upper end with a notch as is clearly indicated in Figs. 2 and 3.

By this construction it will be seen that the core 5 is lifted some distance beyond the position in which it is locked by the locking lever before the locking lever is moved, this upward movement of the core being sufficient to bring the offset 18 of the locking lever actuator above the upper end of the guide 15. In the system illustrated in the drawing the circuit through which the magnet 6 is energized to set the signal at safety is broken by the movement of the locking lever 9 into locking position as will be hereinafter described and the upward movement of the core beyond the position in which it is finally locked in addition to bringing the offset 18 of the locking lever actuator above the upper end of the guide 15 also insures the proper actuation of the locking lever.

As I have stated, after the signal at the entering end of the block has been set at safety the magnet 6 of the apparatus at the entering end of the block is energized each time a car leaves the block. In order to prevent the actuation of the locking lever to release the core 5 until the last car leaves the block, a controller is provided which is actuated when cars enter and leave the block to prevent the actuation of the locking lever to release the core 5 until the last car

leaves the block. This controller comprises a ratchet wheel 23 provided with a flange 24 projecting from one face and extending partially around the circumference of the ratchet wheel and also provided with a spring guide 25, the free end of which projects across one end of the flange 24 into close proximity to the outer surface of the guide 15. The normal position of the ratchet wheel 23 is that indicated in Fig. 2. During the setting of the signal at safety the offset 18 of the locking lever actuator presses back the free end of the spring guide 25 which immediately swings back into the path of movement of the offset so that after the signal has been set at safety if the magnet 6 is energized, the ratchet wheel 23 being in its normal position indicated in Fig. 2, the offset 18, during the upward movement of the core 5, is engaged by the guide 25 and the arm 11 of the locking lever actuator is caused to engage the arm 14 of the locking lever and move the locking lever out of locking position. If, however, the ratchet wheel 23 is not in normal position, but has been advanced one or more steps, the offset 18 is not engaged by the guide 25 but is engaged by the outer surface of the flange 24 and the locking lever actuator is moved so that the arm 11 does not engage the arm 14. After the signal at the entering end of the block is set at safety the ratchet wheel is advanced a step each time a car enters a block and is returned a step towards its normal position each time a car leaves the block.

The ratchet wheel is advanced by means of a spring pressed pawl 26 mounted upon a lever 27 pivoted to the casing of the apparatus at 28 and pivotally connected intermediate its ends to the lower end of a rod 29 secured to or formed integral with the core of a solenoid magnet 30. The magnet 30 is energized each time a car enters the block as will be hereinafter described. A fixed stop 31 located in the path of movement of the pawl 26 limits the movement of the pawl and by pressing the pawl against the teeth of the ratchet wheel prevents an overthrow of the ratchet wheel. The ratchet wheel is acted upon by a spiral spring 33 which tends to return the ratchet wheel to its normal position, a step by step return movement being imparted to the ratchet wheel by means of a pallet 34 provided with detents 35 and 36. The pallet 34 is made in a single integral piece, the detents 35 and 36 being integral therewith. The detents are so arranged that one or the other is always in the path of the teeth of the ratchet wheel. The pallet 34 is provided with studs 37 and 38 located upon opposite sides of its pivot which after the signal has been set at safety are alternately engaged during each upward and downward movement of the core 5 by a cam plate 39 secured to the lower portion of the core 5 by means of a spring hinge connection. The pallet 34 is thus actuated to allow the ratchet wheel to return one step towards its normal position each time a car leaves the block. When the signal is set at safety the cam plate 39 is in engagement with the stud 38 as illustrated in Fig. 3, whereby the detent 35 is yieldingly held in engagement with the teeth of the ratchet wheel 23 so that the ratchet wheel can be advanced a step by the pawl 26 whenever a car enters the block.

When both signals are in their normal position at danger and cars enter the block simultaneously from opposite directions the magnets 30 of both apparatus A and B are energized, but both signals are not set in a position at safety as will be hereinafter described. If at this time the ratchet wheels 23 were advanced a step they would be held in their advanced position by the engagement of either the detent 35 or the detent 36 with a tooth of the ratchet wheel. In order to prevent the ratchet wheels from being so moved, means are provided for holding the pawl 26 out of engagement with the ratchet wheel until the signal is set at safety. These means as illustrated consist of a guard plate 40 pivotally mounted upon the pivot of the ratchet wheel 23 provided with an arm which, when the signal is in its normal position at danger is engaged by a projection 41 on the core 5, the construction being such that when the signal is in this position the guard plate 40 covers the tooth which would otherwise be engaged by the pawl 26 and thus holds said pawl when actuated out of contact therewith. When the signal is set at safety the projection 41 is out of engagement with the arm on plate 40 and the plate is allowed to swing into a position which allows the pawl 26 to engage the teeth of the ratchet wheel. The plate 40 is also provided with an arm upon which is mounted an insulated contact plate 42 which when the signal is set at safety is brought into contact with and rests against a fixed contact 43. The plate 40 is actuated to bring the contact plate 42 into engagement with a spring mounted contact 44 each time the ratchet wheel 23 is moved forward a step, by the engagement of the pawl 26 with a tooth formed on the plate, which tooth is brought into the path of movement of the pawl when the plate 40 is released by the projection 41 on the core 5 during the setting of the signal at safety. The arm of the plate 40 upon which the contact plate 42 is mounted is acted upon by a spring pressed lever 45 which tends to move the plate in a direction to bring the contact plate 42 into engagement with the contact 43. The lever 45 is in connection with a source of current and is in electrical connection with the contact plate 42 and the contacts 43 and 44 are in the circuits of signal lamps to be hereinafter referred to. The lamp in circuit with the contact 44 is an auxiliary signal lamp for indicating an actuation of the ratchet wheel 23 by the pawl 26, the circuit of the lamp being closed after the ratchet wheel has been moved forward a distance slightly greater than the distance between two teeth by the contact of the plate 42 with the contact 44.

The controller may be constructed to allow any desired number of cars to be upon the block at the same time, the controller illustrated in the drawing being arranged to allow five cars to pass on to the block before the first car passes off of the block. In order to prevent an actuation of the controller after the fifth car has passed on to the block, the ratchet wheel 23 is provided with a projection 46 which, after the ratchet wheel has been advanced four steps is brought into the path of movement of the pawl 26 and prevents further movement of the ratchet wheel by the pawl and also holds the pawl out of engagement with the tooth on the plate 40.

In the construction illustrated in Fig. 2 the plate 40 is allowed to return to the position in which the con-

tact plate 42 is in engagement with the contact 43 after the ratchet wheel 23 has been advanced four steps, the movement of the plate 40 being the same for the fourth movement of the ratchet wheel as for the preceding movements. There is therefore nothing to indicate to an approaching car that the block is full and such indication is not given until the car enters the block. In such case the car entering the block does not receive the auxiliary signal indicating an actuation of the controller and so cannot proceed. In Fig. 3 I have illustrated a construction by which after the ratchet wheel 23 has been advanced four steps the plate 40 is held in a position with the contact plate 42 in engagement with the contact 44 so that the auxiliary signal is displayed continuously until a car passes off the block and thereby indicates to an approaching car that the block is full. This construction comprises a pin 47 projecting from the ratchet wheel 23 which is arranged to engage the plate 40 and hold it in a position in which the contact plate 42 is in engagement with the contact 44 after the ratchet wheel has been advanced four steps. It also comprises means for holding the contact 44 in engagement with the contact plate 42 during a portion of the return movement of the plate 40. As illustrated in Fig. 3 the contact 44 is carried by a bent lever 48 pivotally mounted upon a spring pressed lever 49. The bent lever 48 is acted upon by a leaf spring 50 which tends to hold the lever against the stop pin 51 on the lever 49. A spring catch 52 is mounted upon the bent lever 48 and extends into the path of movement of a pin 53 projecting from the arm upon which the contact plate 42 is mounted, the spring catch being free to move when engaged by the pin 53 during the forward movement of the arm carrying the plate 42 and being held from movement during the return movement of the arm by a pin 54 carried by an arm projected from the bent lever 48. The construction illustrated in Fig. 3 and above described is such that during the forward movement of the arm carrying the plate 42 the spring catch 52 is depressed by the engagement with the pin 53 therewith and the plate 42 is brought into engagement with the contact 44 after the ratchet wheel 23 has been advanced a distance somewhat greater than the distance between two teeth, and during the return movement of the arm carrying the contact plate 42, the bent lever 48 is swung about its pivot by the engagement of the pin 53 with the latch 52, the contact 44 remaining in engagement with the contact plate 42 until the arm carrying the contact plate has completed a portion of its return movement. After the ratchet wheel 23 has been advanced four steps the return movement of the arm carrying the contact plate 42 is stopped by the engagement therewith of the pin 47 before the contact 44 is separated from the contact plate 42, whereby the auxiliary signal is continuously displayed until the ratchet wheel 23 is moved backward a step by the passage of a car off of the block.

After the signal at the entering end of the block has been set at safety, if a car enters the block at the same instant that a car leaves the block both magnets 6 and 30 of the apparatus at the entering end of the block are energized. The ratchet wheel 23 will thus be advanced a step and it will be evident without a further explanation that the ratchet wheel must be immediately returned a step in order to allow the signal to be restored to its normal position when the last car leaves the block. To accomplish this result a projection 55 is provided on the core 5 which during the upward movement of the core is raised above the upper end of a spring pressed lever 56. The lever 56 is normally held out of the path of movement of the projection 55 by the engagement with its lower end of an arm projecting from the lever 27. When, however, the magnets 6 and 30 are energized simultaneously the lever 56 is released and allowed to swing under the projection 55 and thereby prevent downward movement of the core 5 until after the magnet 30 has been de-energized and the pawl 26 completed a portion of its return movement, when the lever is removed from beneath the projection 55 by the engagement therewith of the arm 27. The pawl 26 and the pallet 34 are thus actuated successively and the ratchet wheel 23 is moved forward a step and then returned to its original position.

In order to prevent the signal being set at safety by manipulating the target 1, the target instead of being rigidly secured to the rod 3 is yieldingly mounted thereon so that lifting the target by hand will not raise the rod. Setting the signal at safety by rotation of the target by hand is prevented by the engagement of the pin 7 with the straight portion of the groove 8. The manner in which the target is mounted upon the rod 3 is clearly illustrated in Fig. 5. Referring to this figure, 57 indicates a rod of less diameter than the rod 3 extending downwardly therefrom and having secured at its lower end a recessed block 58. A coiled spring 59 surrounds the rod 57 and is situated at its lower end in the recessed block and at its upper end bears against a cross-web 60 of the tubular hub 2 of the target. The target is thus yieldingly supported upon the rod 3 by means of the spring 59 and it will be seen that any upward movement imparted to the disk 1 will merely slide the disk upward on the rod until the hub of the target contacts the bearing 4 without raising the rod. The lower end of the tubular hub 2 is closed by means of a cap so that access to the interior of the hub is prevented.

The construction and arrangement of the various contacts and circuit connections and the operation of the apparatus and of the system as a whole will be clearly understood from an inspection of Fig. 1. Referring to this figure, 61 indicates a feed wire as for instance the trolley wire of an electric street railway and 62 indicates a rail or other return circuit. At each end of the block a circuit closer 63 is located in position to be actuated by cars entering and leaving the block. Each circuit closer is arranged when actuated by a car entering the block to electrically connect the trolley wire with a contact 64 and when actuated by a car leaving the block to electrically connect the trolley wire with a contact 65. It will be understood that any suitable form of circuit closer or circuit closers may be employed to connect the trolley wire with the contacts 64 and 65 when cars enter and leave the block. The form of circuit closer which I prefer to use is disclosed in my prior patent 711,036, dated Oct. 14, 1902. Each contact 64 is connected by means of a wire 66 to one terminal of a magnet 30, the other terminal of which is

connected by means of a wire 67 to the return 62. At each end of the block the trolley wire 61 is connected by means of a wire 68 to a contact 69, which when the core of magnet 30 is in its lowest position is engaged by a contact plate 70 mounted upon the upper end of the core of magnet 30. The contact plate 70 is in electrical connection with a wire 71 which leads to one terminal of a magnet 72, the other terminal of which is connected by a wire 73 to a contact 74. The contact 74, when the core of magnet 6 is in its lowest position, is engaged by a contact plate 75 mounted upon the upper end of the core of magnet 6. The contact plate 75 is in electrical connection with a line wire which extends from one apparatus to the other. In the arrangement shown in the drawing two of these line wires are provided, the line wire connected to the contact plate 75 of apparatus A being indicated at 76, and the line wire in electrical connection with the contact plate 75 of apparatus B being indicated at 77. The line wire 76 is in electrical connection with a contact plate 78 on the armature lever of the magnet 72 of apparatus B, and the line wire 77 is in electrical connection with the corresponding contact plate 78 of the armature of the magnet 72 of apparatus A. Each contact plate 78 is normally in engagement with a contact 79 which is connected by means of a wire 80 to the retracting spring 10 of the locking lever 9. The locking lever 9 is provided with a contact plate in electrical connection with the spring 10 and which when the core of magnet 6 is in its lowest position is in engagement with a contact 82. The contact 82 is connected by means of a wire 83 to a contact plate 84 mounted upon the rod 29 which is secured to the core of magnet 30. Above the contact plate 84 and in position to be engaged thereby when the rod 29 is raised is a contact 85 which is connected by a wire 86 to one terminal of the magnet 6, the other terminal of the magnet being connected to the return 62 by means of a wire 87. Above the contact plate 78 of the armature of magnet 72, and in position to be engaged thereby when the magnet 72 is energized is a contact 88 which is connected by means of a wire 89 to the contact 65.

A contact 750 is arranged above the contact plate 75 and is constructed to remain in engagement with the contact plate 75 during the upward and downward movements of the core of magnet 6 after the signal has been set at safety and to be separated therefrom only when the core of magnet 6 drops to restore the signal to its normal position at danger. The contact 750 is connected by means of a wire 751 to one terminal of the magnet 6.

By means of the contacts and connections above described, the signals are actuated when cars enter and leave the block as follows: Both signals being in their normal position at danger, when a car enters the block from the left, the circuit closer 63 at that end of the block is actuated to connect the trolley wire 61 to the contact 64. A current is thereby transmitted through the magnet 30 and the rod 29 is raised bringing the contact plate 84 into engagement with the contact plate 85. A circuit is thus closed through the magnet 6 of the apparatus at the entering end of the block as follows: Wire 68 of apparatus B, contact 69, contact plate 70, wire 71, magnet 72, wire 73, contact 74, contact plate 75, line wire 77, contact plate 78 of the armature of magnet 72 of apparatus A, contact 79, wire 80, spring 10, contact plate of locking lever 9, contact 82, wire 83, contact plate 84, contact 85, wire 86, magnet 6, and wire 87. The core 5 of the magnet 6 of apparatus A is thus raised and the target 1 of apparatus A is set at safety and locked in such position by the engagement of the locking lever 9 with the shoulder at the lower end of the enlarged portion of rod 3. As the locking lever 9 swings into locking position, the contact plate thereof is separated from the contact 82 and thereby this circuit through the magnet 6 is broken, the magnet is de-energized and the core is allowed to drop until stopped by the engagement therewith of the locking lever. The positions of the various parts of the signal apparatus at this point in the operation are as indicated in Fig. 3. In order to maintain the magnet 72 of apparatus B energized, for a purpose to be presently explained, after the circuit through the magnet 6 is broken by the separation of the contact plate on the locking lever 9 from the contact 82, a spring contact plate 90 in electrical connection with the wire 80 is provided which when the core of magnet 6 is in its lowest position is held out of engagement with a contact 91 by means of a projection 92 of insulating material on the core of the magnet. The contact 91 is connected to a wire 93 which leads to the return 62. By this construction during the upward movement of the core of magnet 6 the spring contact plate 90 is allowed to engage the contact 91 and thereby a circuit including magnet 72 of apparatus B is closed as will be apparent without further description.

The movement of the armature of magnet 72 of apparatus B brings the contact plate 78 into engagement with the contact plate 88 thereby disconnecting the line wire 76 from the wire 80 of apparatus B and connecting it to wire 89 which leads to contact 65. The purpose of maintaining the magnet 72 energized is to keep the line 76 connected to the line 89 in order to furnish a circuit through which the magnet 6 of the apparatus at the entering end of the block may be energized when cars leave the block. When the car which has entered the block from the left leaves the block, the circuit closer 63 at the leaving end of the block is actuated to connect the trolley wire 61 to the wire 89 of apparatus B. A circuit through the magnet 6 of apparatus A is thereby closed as follows: Wire 89 of apparatus B, contact 88, contact plate 78, line wire 76, contact plate 75 of apparatus A, contact 750 with which the contact plate 75 is in engagement when the signal of apparatus A is set at safety, wire 751, magnet 6 and wire 87. If one or more cars enter the block from the left before the first car leaves the block, the controller will be actuated as hereinbefore described and the signal at the entering end of the block will be restored to its normal position at danger only when the last car leaves the block.

The operation when cars going in the same direction enter and leave the block simultaneously and when cars simultaneously enter the block from opposite directions will be readily understood from the description already given of the construction and mode of operation of the signal apparatus.

It will be noted that when cars enter the block from the left, the line wire 77 is utilized in setting the signal at the entering end of the block and the line wire 76 is utilized in restoring the signal to normal condi-

tion. When cars enter the block from the right the line wire 76 is utilized in setting the signal at the entering end of the block and the wire 77 is utilized in restoring the signal to its normal position as will be apparent from an inspection of Fig. 1 without further description.

It will also be noted that by the use of two line wires in connection with the magnets 72 an improper actuation of the signals is prevented in case there is a ground on one of the line wires. Thus, if there is a ground on the line wire 77, for instance, the signal of apparatus A will not be moved to its safety position when a car enters the block from the left, and the system will be inoperative for cars going in one direction. In such a case it is also desirable that the system be rendered inoperative for cars going in the opposite direction, and in the arrangement illustrated in Fig. 1 this is accomplished by the separation of the contact plate 78 from the contact 79, the magnet 72 of apparatus B being energized by current flowing through line wire 77 to the ground and the separation of the contact plate 78 from the contact 79 breaking the circuit through which the signal of apparatus B is set at safety by cars entering the block from the right.

In addition to the targets 1 the apparatus indicated in Fig. 1 are also provided with electric lamps which may be utilized for night signaling in place of the targets 1 or as auxiliaries thereto. Each apparatus is also provided with an auxiliary signal lamp for indicating an actuation of the controller when a car enters the block and for also indicating when the number of cars which the controller is constructed to allow upon the block at one time are upon the block. These lamps are indicated at 94, 95 and 96. The lamp 94 is adapted to give a red light and is utilized as a danger signal. One terminal of this lamp is connected by a wire 97 which includes a suitable resistance 98 to the return 62 and the other terminal is connected to a contact 99. Adjacent to the contact 99 is a contact 100 which is connected by a wire 101 to the trolley wire 61. A contact plate 102 on the armature lever of magnet 72 is arranged to bridge the contacts 100 and 99 when the magnet is energized and thereby close the circuit of the lamp. As will be apparent from the preceding description the magnet 72 of the apparatus at the distant end of the block is kept energized so long as the signal at the entering end of the block remains set at safety. The lamp 94 at the distant end of the block therefore remains lighted while a car is on the block and serves as a danger signal in the place of or in addition to the target 1.

The lamp 95 is adapted to give a green light and is utilized as a safety signal. One terminal of this lamp is connected by means of wire 103 to the resistance 98 and the other terminal is connected by means of a wire 104 to the contact 43. The lamp 96 is adapted to give a white light and is utilized as an auxiliary signal to indicate an actuation of the controller. One terminal of this lamp is connected by means of a wire 105 to the resistance 98 and the other terminal is connected by means of the wire 106 to the contact 44. The spring-actuated lever 45 is in electrical connection with the contact plate 42 and is connected by means of a wire 107 to the trolley wire 61. As has been hereinbefore described when the signal is in its normal position at danger the contact 42 is held out of engagement with both contacts 43 and 44. When the signal is set at safety the contact plate 42 is brought into engagement with the contact 43 and thereby the circuit of the lamp 95 is closed. Each time a car enters the block after the signal at the entering end of the block is set at safety, the contact plate 42 is brought into engagement with the contact 44 and is then returned into engagement with the contact 43. The circuit of lamp 95 is thus momentarily broken and the circuit of lamp 96 is momentarily closed. The lamp 96 is thus momentarily lighted to indicate that the controller has been actuated when a car enters the block. When a fifth car enters the block before the first car has left the block the contact plate 42 remains in engagement with the contact 44 as has been hereinbefore described and the lamp 96 remains lighted until the controller has been moved backward a step by the passage of a car off of the block. The lamp 96 thus indicates to an approaching car that the block is full.

It is desirable that means be provided for preventing the setting of the signal at the entering end of the block at safety when a car enters the block in case the circuit through which current is transmitted when a car leaves the block to restore the signal is connected to a source of current as by a cross on the line wire through which a current is transmitted when a car leaves the block.

As has been described, in the system illustrated in Fig. 1 the line wire 76 is utilized in transmitting current to restore the signal when cars pass through the block from left to right, and the line wire 77 is utilized to transmit the current to restore the signal at the entering end of the block when cars pass through the block from right to left. In the system illustrated in Fig. 1 it will be seen that if the signal of apparatus A is set at safety while the line wire 76 is connected to a source of current, a current will be transmitted through the magnet 6 immediately upon the engagement of the contact plate 75 with the contact 750 and thereby the core of the magnet will be held raised permanently. In the same manner the core of magnet 6 of apparatus B would be held permanently raised if the signal of apparatus B were set at safety when the line wire 77 was connected to a source of current. In order to prevent the setting of the signals in such a case a contact plate 108 is provided above the contact plate 70 in position to be engaged by the contact plate 70 before the contact plate 84 is brought into engagement with the contact 85 and the contact plate 108 is connected by means of a wire 109 to the wire 93. By this construction if the line wire 76 is connected to a source of current when a car enters the block from the left, the plate 70 of apparatus A is brought into engagement with the contact 108 and thereby a current is transmitted through the magnet 72 of apparatus A which being thus energized draws up its armature and separates the contacts 78 and 79 thereby breaking the circuit through which the magnet 6 of apparatus A is energized to set the signal at safety and preventing the setting of the signal. The circuit through which the current is transmitted to wire 76 through the magnet 72 consists of the contact plate 75, contact 74, wire 73, magnet 72, wire 71, plate 70, contact 108, and wires 109 and 93. In the same manner a current is transmitted through the magnet 72 of apparatus B

when a car enters the block from the right in case the line wire 77 is connected to a source of current as will be obvious without further description. It is also desirable to prevent the setting of one signal when the line wire through which current is transmitted to set the other signal is connected to a source of current by a cross on the wire as in such case the setting of one signal at safety when a car enters the block from one direction will not prevent the other signal from being set at safety when a car enters the block from the opposite direction. Thus if a cross exists on the wire 77 which forms a portion of the circuit through which the magnet 6 of apparatus A is energized to set the signal of this apparatus the setting of the signal of apparatus B at safety will not prevent the energizing of magnet 6 of apparatus A when a car enters the block from the left, a circuit through the magnet being completed by the engagement of contact plate 84 of apparatus A with contact 85. The arrangement above described prevents the setting of one signal when a cross exists on the line wire through which current is transmitted to set the other signal and I consider an arrangement for effecting this result to constitute a feature of my invention whether or not the line wires are also utilized to transmit current to restore the signals.

The circuit connections illustrated in Fig. 7 are the same as those illustrated in Fig. 1 with the exception that a magnet 110 is included in the wire 89 between the contact 65 and the contact 88, this magnet being arranged to act upon the armature of magnet 72 and move it in the opposite direction to that in which it is moved under the influence of magnet 72, and with the exception that the contact 91 instead of being connected directly to the wire 93 is connected by means of a wire 112 to a contact spring 113 which is arranged to bear against a contact plate 114 on the latch 20 which contact plate is in electrical connection with the wire 93. The arrangement of the contact plates 113 and 114 is such that they are only brought into engagement when latch 20 is held in its depressed position by the engagement therewith of the pin 22 the contact plates being out of engagement at all times except when the signal is in its normal position at danger. The armature is held in the position to which it is moved by either magnet 110 or 72 by means of a spring 111 which is arranged to swing over the pivotal center of the armature when the armature is swung from one position to the other. The provision of the magnet 110 and of the contact plates 113 and 114 is for the purpose of preventing the signal at one end of the block from being set at safety when a car enters that end of the block unless the signal at the other end of the block has been returned to its normal position at danger by the passage of a car off of the block. That is, if, after a car has entered the opposite end of the block to that shown in Fig. 7, the signal of the apparatus at the opposite end of the block is returned to its normal position at danger before the car passes out of the block, the entrance of a car onto the end of the block illustrated in Fig. 7 will not operate to set the signal of the apparatus at that end of the block at safety. The manner in which this result is accomplished will be apparent from an inspection of the drawing, from which it will be seen that the contact plate 78 will be held in engagement with the contact 88 and out of engagement with the contact 79 until a current is transmitted through the magnet 110, which occurs only when a car passes off of the block. So long as the contact plate 78 remains in engagement with contact 88 the circuit, through which magnet 6, indicated in Fig. 7, is energized to set the signal, is broken at the contacts 78 and 79 and therefore if the signal at the other end of the block is returned to its position at danger by any other means than by the passage of a car off of the block, the entrance of a car on to the end of the block illustrated in Fig. 7 will not cause the magnet 6 of the apparatus at that end of the block to be actuated to set the signal at safety.

It will be seen that in the signal system illustrated in the drawings the circuit through which current is transmitted to set the signal at one end of the block is broken when the signal at the other end of the block is set by the separation of the contacts 74 and 75. 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 at danger. It will also be seen that the circuit by which the signal at one end of the block is set at safety is broken, whenever the magnet 30 of the apparatus at the other end of the block is energized, by the separation of the contacts 70 and 69. The simultaneous entrance of cars upon the block from opposite directions will therefore fail to set either signal. If desired, the circuit closers 63 at the opposite ends of the block may be differently timed so that one circuit closer will remain closed longer than the other. By this means one of the signals will be set even if cars enter the block simultaneously from opposite directions, the other signal, however, remaining in its normal position at danger and thus preventing the car which has entered the block at that end from proceeding. The movement of the contact plates 78 from the contacts 79 to the contacts 88 in addition to accomplishing the results hereinbefore referred to also serve to produce a second break in the circuits through which the signals are set at safety.

Having thus described my invention but without limiting the various features thereof to the specific constructions, arrangements and circuit connections illustrated in the drawings and above described, I claim as new and desire to secure by Letters Patent:

1. 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, a latch arranged to hold the locking device out of engagement with the armature after its release, and means for actuating the latch to release the locking device, substantially as described.

2. A railway block signal system, having, in combination, a magnet, an armature therefor, a signal actuated by the armature, a locking lever for preventing the return of the armature to normal position after having been attracted to set the signal, means carried by the armature for actuating the locking lever upon a subsequent attraction of the armature to release the armature, a latch arranged to hold the locking lever out of engagement with the armature after its release, and means carried by the armature for actuating the latch to release the locking lever when the armature returns to normal position, substantially as described.

3. A railway block signal system, having, in combination, a magnet, a longitudinally movable and rotatable 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, and an actuator for the locking device mounted to rotate with the armature and to be moved to actuate the locking device to release the armature upon a subsequent attraction of the armature, substantially as described.

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, means for advancing the ratchet wheel step by step, a spring for returning the ratchet wheel, an escapement pallet provided with detents integral therewith, studs rigid with the pallet on opposite sides of its pivot, a yieldingly mounted cam plate and means for reciprocating the cam plate to engage said studs alternately, substantially as described.

5. 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, an auxiliary signal for indicating an actuation of the controller when a car enters the block, means for momentarily displaying said auxiliary signal when a car enters the block, and means for continuously displaying said auxiliary signal when a predetermined number of cars are on the block, substantially as described.

6. A railway block signal system, having, in combination, a signal, signal setting and restoring means, a controller for said restoring means, means for actuating the controller to prevent the restoration of the signal by said restoring means until the last car leaves the block, means for indicating an actuation of the controller when a car enters the block, and means for indicating to a car approaching the block the presence of a predetermined number of cars on the block, substantially as described.

7. A railway block signal system, having, in combination, a signal, signal setting and restoring means, a controller for said restoring means, means for actuating the controller to prevent the restoration of the signal by said restoring means until the last car leaves the block, and means for indicating to a car approaching the block the presence of a predetermined number of cars on the block, substantially as described.

8. A railway block signal system, having, in combination, a signal, electrical apparatus actuated when cars enter and leave the block to set and restore the signal, means for closing a circuit through said apparatus to set the signal when a car enters the block, means for closing a circuit through said apparatus to restore the signal when a car leaves the block, and means for preventing the setting of the signal while the circuit which is closed by a car leaving the block is connected to a source of current, substantially as described.

9. A railway block signal system, having, in combination, a signal at each end of a track section or block, means for setting one signal at safety when a car enters the block in one direction, means for restoring said signal when a car leaves the block, means for setting the other signal at safety when a car enters the block in the other direction, means for restoring said signal when a car leaves the block, and means for preventing the setting of one signal at safety if the other signal is restored by means other than a car leaving the block, substantially as described.

10. A railway block signal system, having, in combination, a signal at each end of a track section or block standing normally at danger, signal setting and restoring means acting to set the signal at the entering end of the block at safety when a car enters the block from either direction, and to restore the signal when a car leaves the block, and means for preventing the setting of one signal at safety while the other signal is at safety, substantially as described.

11. A railway block signal system, having, in combination, a signal at each end of a track section or block standing normally at danger, a locking device for each signal, and signal setting and restoring means acting to set the signal at the entering end of the block at safety when a car enters the block from either direction, and to actuate the locking device of said signal to release the signal when a 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 standing normally at danger, a locking device for each signal, means for setting the signal at the entering end of the block at safety when a car enters the block from either direction, means for actuating the locking device of the signal at the entering end of the block to release the signal when a car leaves the block, a controller and means for actuating the controller to prevent the actuation of said locking device until the last car leaves the block, substantially as described.

13. A railway block signal system, having, in combination, a signal at each end of a track section or block standing normally at danger, an actuating magnet for each signal, means for closing a circuit including the magnet of the signal at the entering end of the block when a car enters the block from either direction, and means actuated by the movement of the signal at the entering end of the block to safety for breaking the circuit of the magnet of the signal at the distant end of the block, substantially as described.

14. A railway block signal system, having, in combination, a signal at each end of a track section or block, a signal setting magnet for each signal acting when energized to set the signal at safety, two line wires, means for closing a circuit including the signal setting magnet at the entering end of the block and one of the line wires when a car enters the block in either direction, 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, a magnet in said circuit at the distant end of the block, a source of current connected to said circuit at the distant end of the block, and means actuated by said last mentioned magnet when energized by a ground on a line wire for preventing a closure of the circuit including the signal setting magnet at the distant end of the block by a car entering that end of the block.

15. A railway block signal system, having, in combination, a signal at each end of a track section or block standing normally at danger, means for setting the signal at the entering end of the block at safety when a car enters the block from either direction, means for restoring the signal when a car leaves the block, a controller for said restoring means, and means for actuating the controller to prevent the restoration of the signal until the last car leaves the block, substantially as described.

16. A railway block signal system, having, in combination, a signal at each end of a track section or block standing normally at danger, an actuating magnet for each signal, means for closing a circuit including the magnet of the signal at the entering end of the block when a car enters the block from either direction, means including the actuating magnet of the signal at the entering end of the block for restoring said signal, and means for closing a circuit including said magnet when a car leaves the block, substantially as described.

17. A railway block signal system, having, in combination, a signal at each end of a track section or block standing normally at danger, an actuating magnet for each signal, means for closing a circuit including the magnet of the signal at the entering end of the block when a car enters the block from either direction, means including the actuating magnet of the signal at the entering end of the block for restoring said signal, means for closing a circuit including said magnet when a car leaves the block, a controller for said restoring means acting to prevent the restoration of the signal until the last car leaves the block, means for actuating said controller when cars enter the block, and means including said actuating magnet for actuating the controller when cars leave the block, substantially as described.

18. A railway block signal system, having, in combination, a signal at each end of a track section or block, electrical apparatus at each end of the block for actuating said signals, two line wires, means for closing a circuit including one of the line wires through the apparatus at one end of the block to set a signal when a car enters the

block from one direction, means for closing a circuit including the other line wire through the apparatus at the other end of the block to set a signal when a car enters the block from the opposite direction, and means for preventing the setting of one signal while the wire through which current is transmitted to set the other signal is connected to a source of current, substantially as described.

19. A railway block signal system, having, in combination, a signal at each end of a track section or block, electrical apparatus at each end of the block for actuating said signals, two line wires, means for closing a circuit including one of the line wires through one apparatus to set a signal when a car enters the block from one direction, means for closing a circuit including the other line wire through said apparatus to restore the signal when a car leaves the block, means for closing a circuit including said last-mentioned wire through the other apparatus to set a signal when a car enters the block from the opposite direction, and means for closing a circuit including the other wire through said last-mentioned apparatus to restore the signal when a car leaves the block, substantially as described.

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

WINTHROP M. CHAPMAN.

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