No. 782,751. PATENTED FEB. 14, 1905.

W. S. JACKSON.

AUTOMATIC ELECTRIC RAILWAY SIGNAL.

APPLICATION FILED JAN. 9, 1904.

4 SHEETS—SHEET 1.

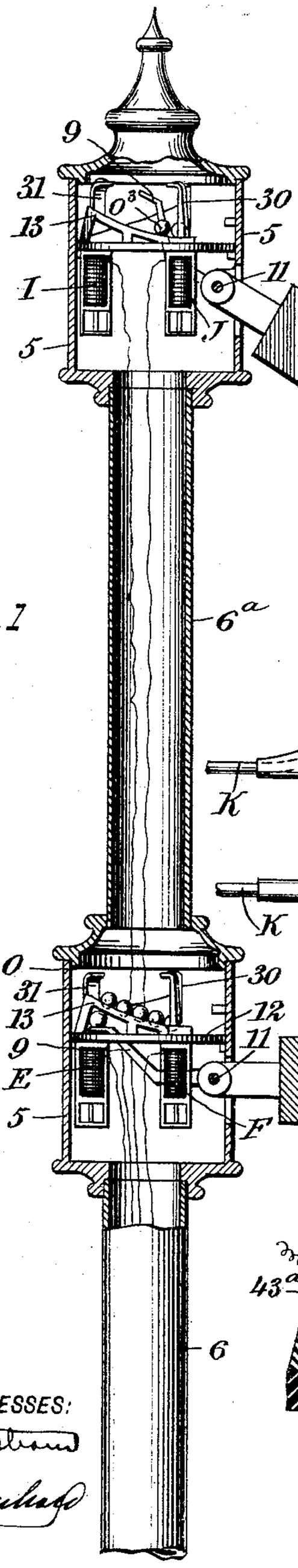


FIG. 1

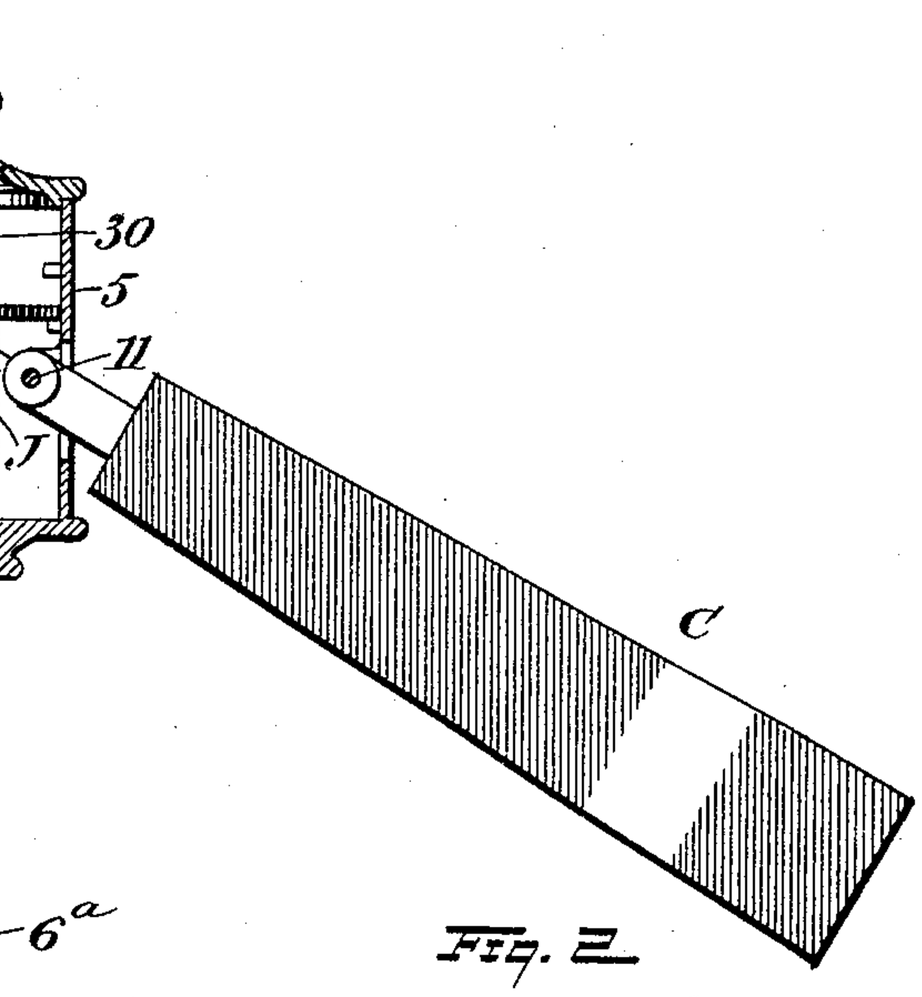


FIG. 2

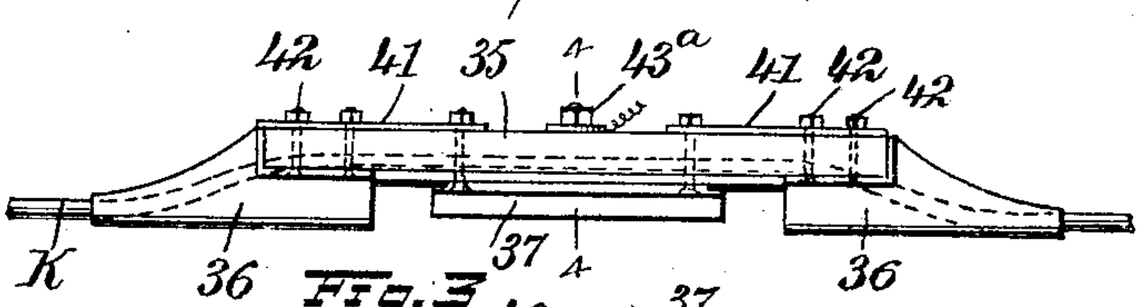
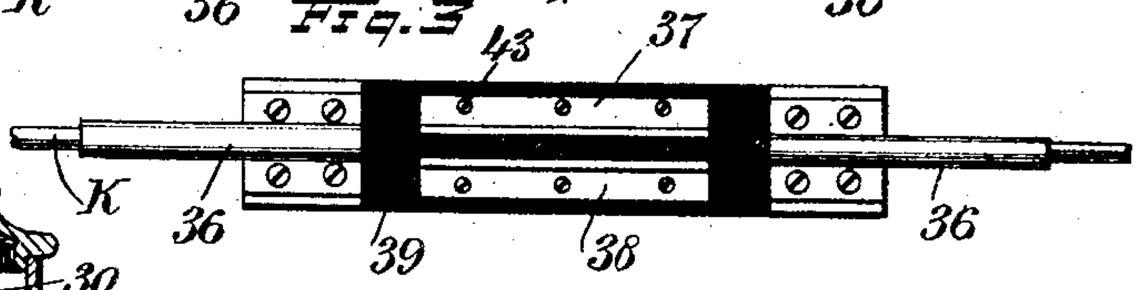


FIG. 3



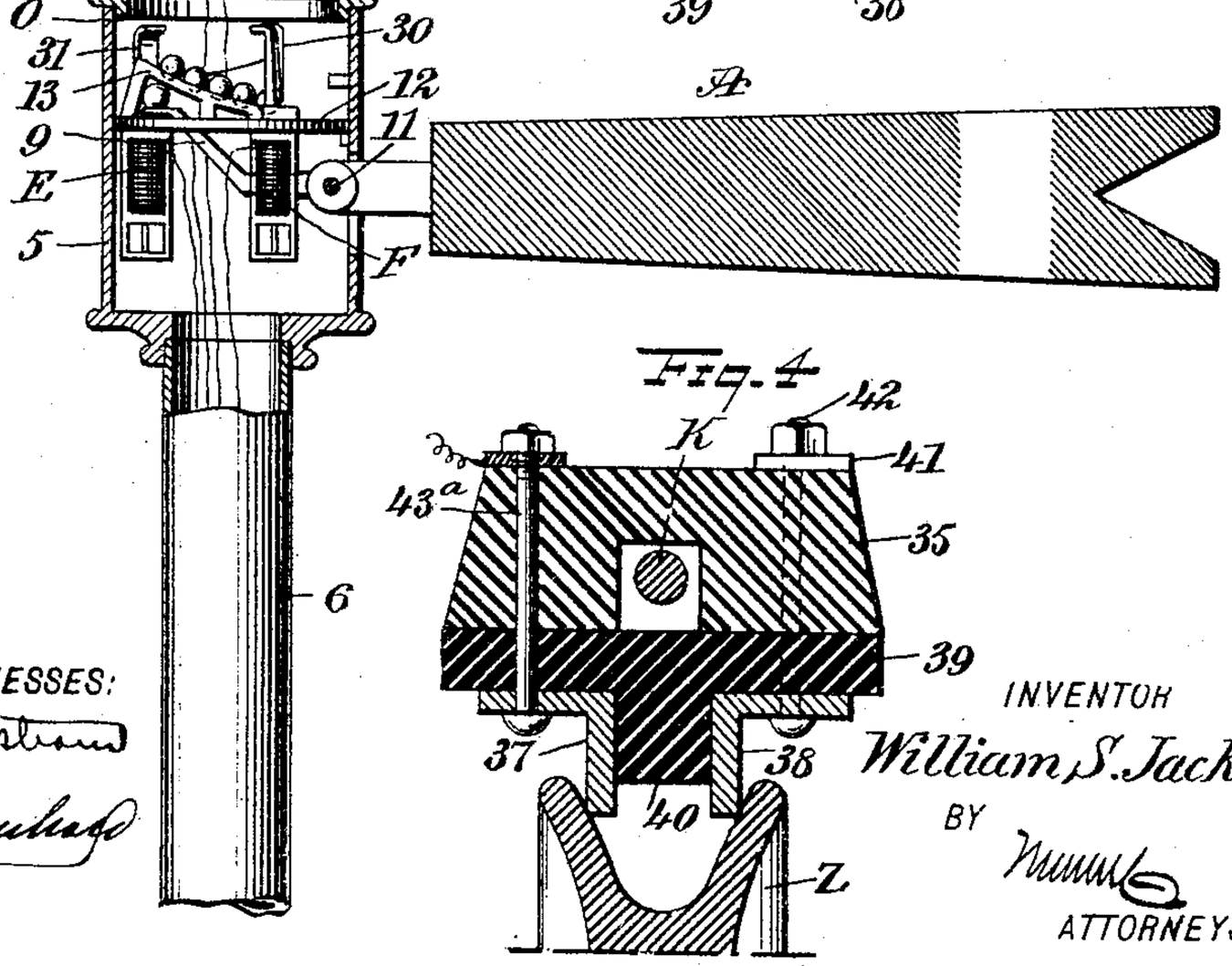


FIG. 4

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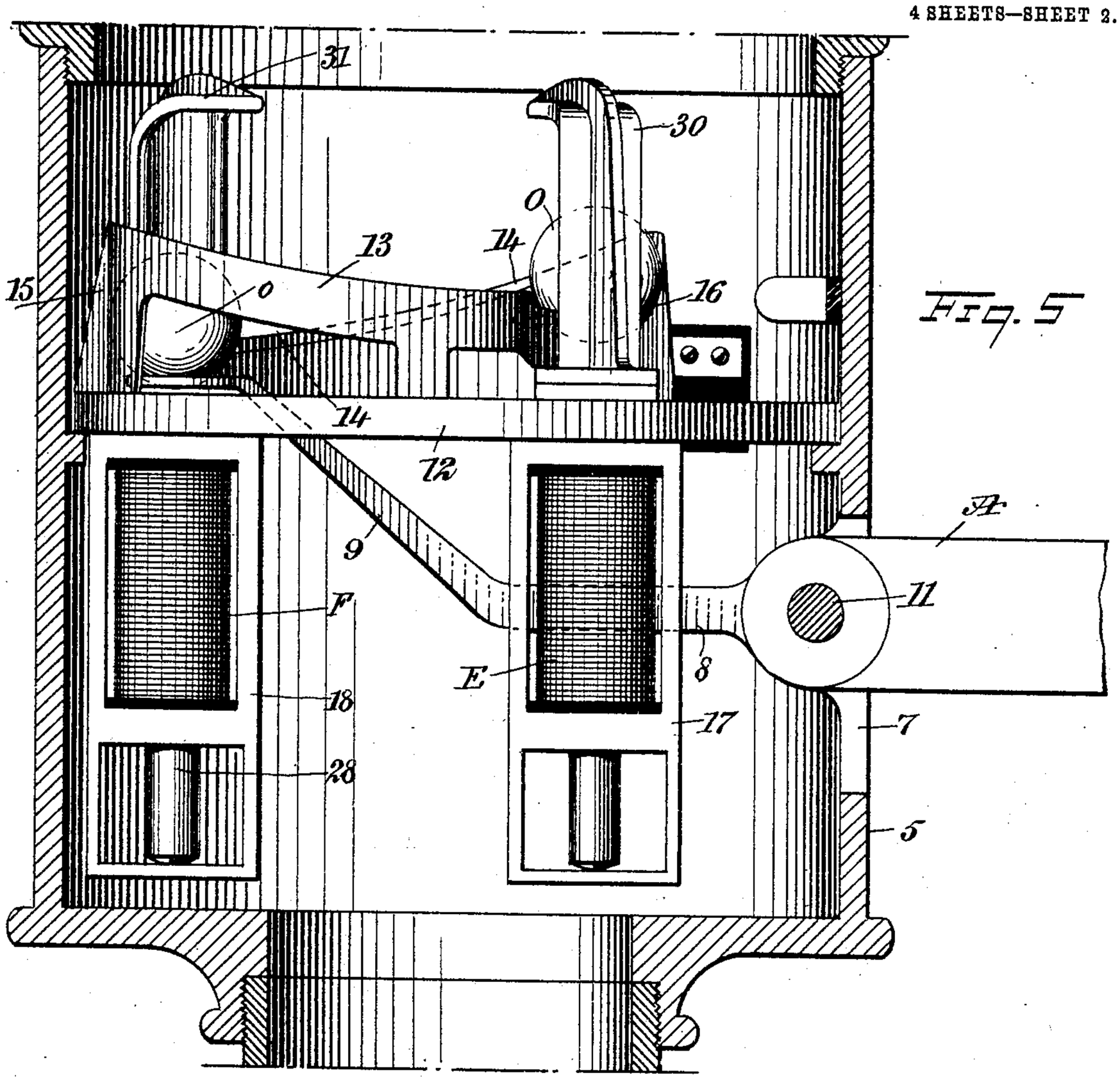

Fig. 5

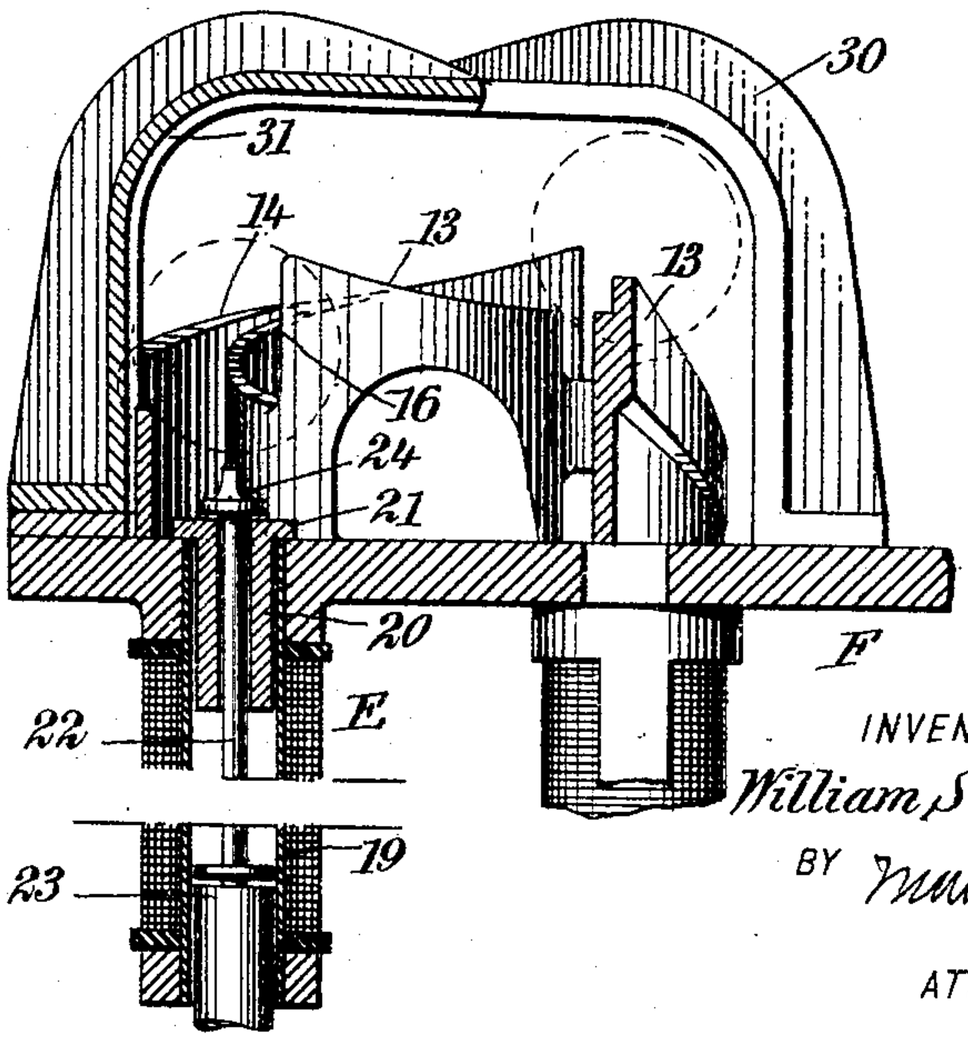

Fig. 6

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4 SHEETS—SHEET 3.

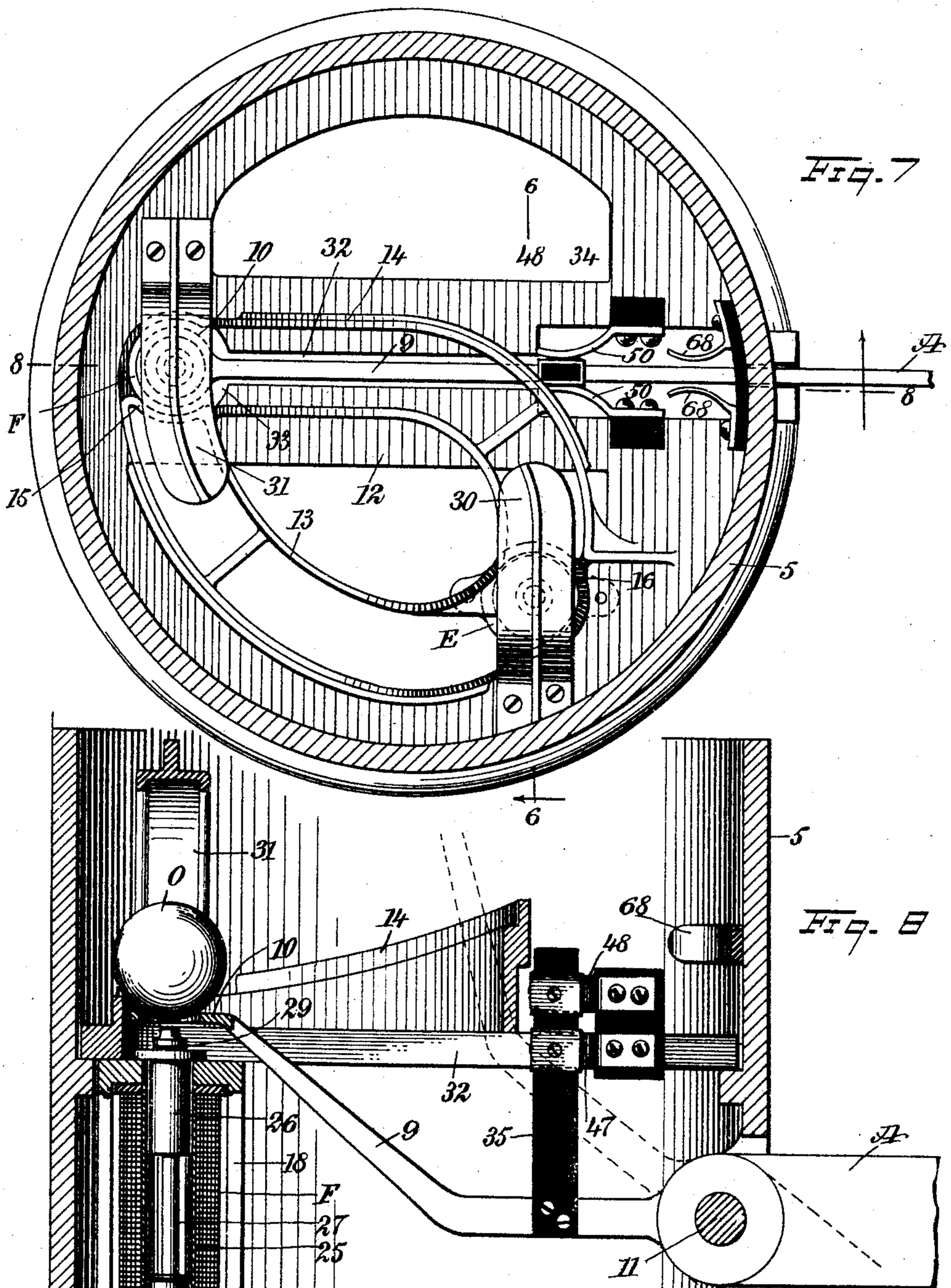

Fig. 7

Fig. 8

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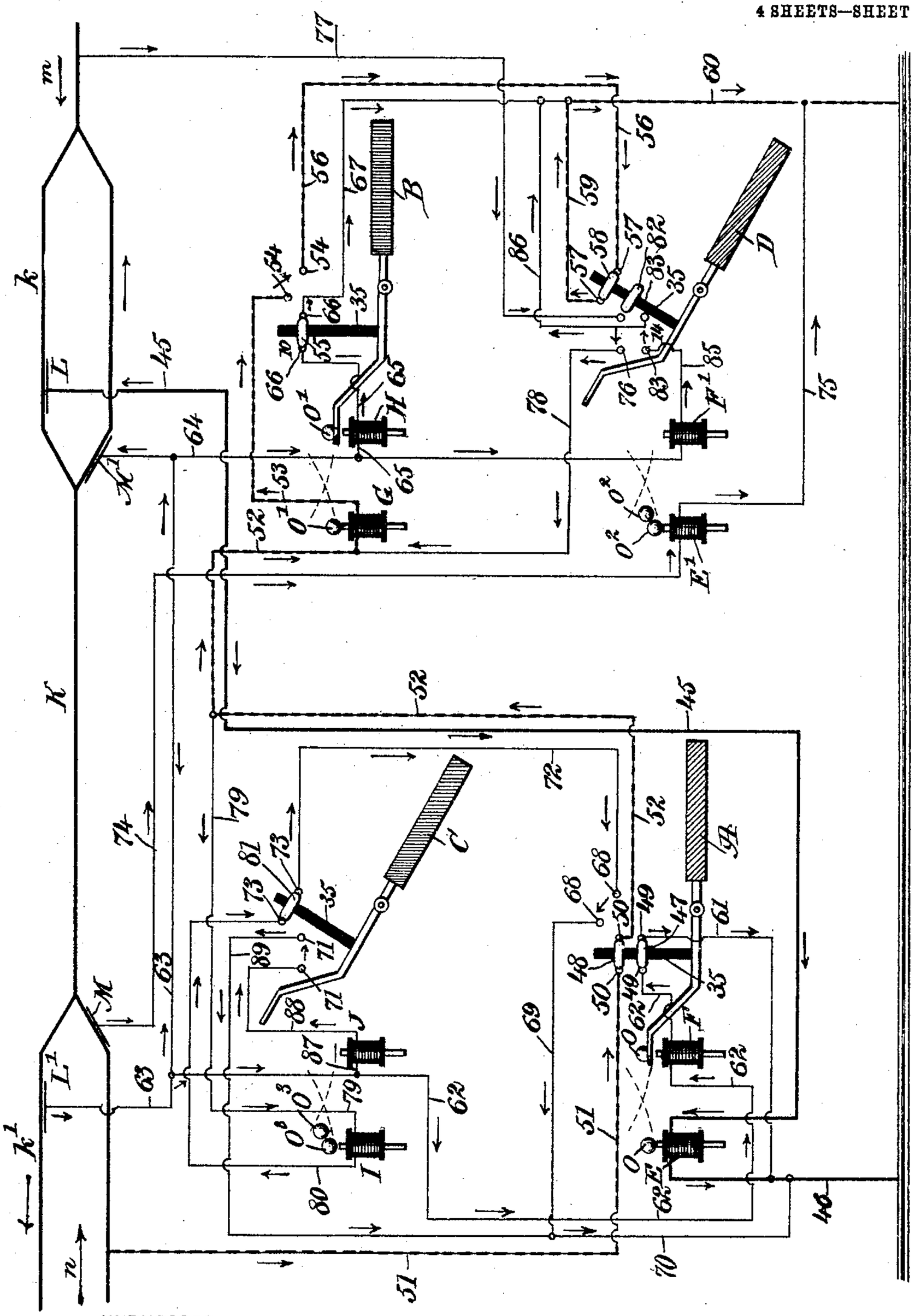

Fig. 1.

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No. 782,751. Patented February 14, 1905.

UNITED STATES PATENT OFFICE.

WILLIAM S. JACKSON, OF HOBOKEN, NEW JERSEY, ASSIGNOR OF ONE-HALF TO DAVID YOUNG, OF NEWARK, NEW JERSEY.

AUTOMATIC ELECTRIC RAILWAY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 782,751, dated February 14, 1905.

Application filed January 9, 1904. Serial No. 188,302.

To all whom it may concern:

Be it known that I, WILLIAM S. JACKSON, a citizen of the United States, and a resident of Hoboken, in the county of Hudson and State of New Jersey, have invented a new and Improved Automatic Electric Railway-Signal, of which the following is a full, clear, and exact description.

My invention relates to automatic railway-signals especially designed for use in connection with single-track trolley-railways whereon cars are adapted to travel in opposite directions on the same track, although the improved devices may by modification in the system be employed on double-track railroads and on other kinds of railways than trolley-roads.

It is one purpose of this invention to provide in a signal system an improved form of semaphore-controlling mechanism by which a number of cars all traveling in the same direction—from two, three, to any number indefinitely—may be admitted to a "block" or section of the railway in order to meet unusual demands of traffic in one direction over the railway—as, for example, in handling passengers at certain hours for a certain destination—at which time the travel in the other direction over the road is relatively small. Under these conditions at least four of the semaphore-controlling devices and their appropriate number of four semaphores are used, and these four devices are connected in two sets by electrical circuits which are normally open and are adapted to be closed by cars traveling in opposite directions, the closing of the circuits being effected independently by the trolley-wheels of the different cars. Each circuit has its semaphore-controlling devices and the semaphores located at the points of entrance and departure of the block, the distant semaphore being of one color, as red, to denote "danger" and the entrance-signal of another color, as green, to indicate "caution," and the controlling devices in each circuit are so related that the entrance of a car moving in one direction will operate to first move the distant or "red" semaphore to a displayed position in order to warn a car traveling in the other direction over the same track that the block is occupied, while immediately following the display of the distant signal the entrance or "green" semaphore is moved to a displayed position for the purpose of notifying a car following the first car and moving in the same direction that the block is occupied and to proceed cautiously. The signal-controlling device for the distant or red semaphore is adapted for actuation a number of times by the desired number of cars entering and departing in one direction into and from the block, while the controlling device for the entrance-signal is operated each time a car enters the block, the two semaphores when all the cars moving in one direction depart from the block being moved automatically to lowered or safety positions in order to indicate that the track is clear.

Each signal-controlling device of my invention is simple in construction, being characterized by an absence of ratchets, gearing, and springs, so that the device is positive, reliable, and efficient in operation. This controlling device is designed to utilize the simple mechanical principles of the counterbalance, the inclined plane, and the lever directly applied. Said device dispenses entirely with auxiliary locking devices for the semaphore and with a live switch for operation of the semaphore, nor is there any dead resistance employed.

As parts of each signal-controlling device I employ two magnets or solenoids, each designed for the operation of a core or plunger that is lifted with sufficient force to raise a rolling weight, the latter being adapted to raise the semaphore and hold it in a displayed position; but when this weight is removed from the semaphore the latter drops by gravity to a safety position. Each magnet or solenoid is of peculiar construction with a view to quickening the action of the plunger for the operation of the rolling weight that sets, locks, and releases the semaphore.

Further objects and advantages of the invention will appear in the course of the subjoined description, and the actual scope thereof will be defined by the annexed claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional elevation of a post or column, illustrating danger and cautionary signals mounted thereon and independent controlling devices for said signals. Fig. 2 is a side elevation of a trolley-switch adapted for use in the system of my invention. Fig. 3 is an inverted or bottom plan view of the trolley-switch shown by Fig. 2. Fig. 4 is an enlarged vertical cross-section through the trolley-switch on the plane of the dotted line 4 4 of Fig. 2 and showing the mode of closing a signal-circuit through a trolley-wheel. Fig. 5 is an enlarged view of one of the signal-controlling devices, showing the parts in side elevation and the casing or housing in vertical section. Fig. 6 is a vertical sectional elevation taken in the plane of the dotted line 6 6 of Fig. 7 looking in the direction of the arrow. Fig. 7 is a horizontal section through the casing or housing of Fig. 5 and showing the signal-controlling devices in plan view. Fig. 8 is a vertical section in a plane at right angles to that of Fig. 6 and on the dotted line 8 8 of Fig. 7 looking in the direction of the arrow; and Fig. 9 is a diagrammatic view of the system, illustrating one method of wiring and including four semaphores and their appropriate controlling devices, the system being applied to or used in connection with a single-track railway and a trolley-conductor having turnouts, said signaling system including two circuits adapted for operation by cars passing in opposite directions over the same track and each circuit comprising means for setting danger and cautionary signals at the points of departure and entrance, respectively, of a block.

I will first proceed to describe the signal-controlling mechanism represented by Figs. 5 to 8, inclusive, wherein the working parts of the signal-controlling device are shown as being contained within a suitable casing or housing 5, the latter being adapted for application to a post or column 6 in order to be supported thereon, as shown by Fig. 1. This casing or housing is shown by the drawings as being cylindrical; but the shape and dimensions of the casing are immaterial and may be varied at pleasure. The casing is shown as having a vertical slot 7 in one side thereof, and through this slot passes a semaphore, (indicated at A,) four of these semaphores being used in the system shown by Fig. 9 of the drawings. The semaphore is shown as having an inwardly-extending arm 8, which is bent or inclined at 9 and provided with an eye-formed extremity 10, as shown by full lines in Fig. 8 and by dotted lines in Fig. 7. The semaphore is pivotally supported at a point between the blade and the arm by a bolt or shaft 11, which passes through the semaphore and is supported in the casing or housing 5 at a point adjacent to the vertical slot 7, whereby the semaphore is pivotally mounted for movement in a vertical plane and on a horizontal axis afforded by the pivotal bolt or arbor 11.

In the upper part of the casing 5 a horizontal frame or bed-plate 12 is secured above the pivot for the semaphore by any suitable means, and this frame or bed-plate supports or carries a magazine 13 and a runway 14. The magazine is designed for the reception of a plurality of rolling weights, which may vary in number from two to five or more, and this magazine is curved lengthwise and is inclined downwardly from the path of movement of a restoring-solenoid core toward the path of a setting-solenoid core. The runway 14 is also curved throughout its length, and it inclines downwardly from the path of movement of the setting-solenoid core toward a restoring-solenoid, two of the solenoids being indicated at E F, wherein the setting-solenoid is designated at E and the restoring-solenoid at F. The magazine 13 and the runway 14 are inclined in opposite directions, and in one form of construction said magazine and the runway are cast in one piece with the frame or bed 12, although it is evident that the parts may be made separately and united in the manner shown by the several figures of the drawings. When the magazine and the runway are in one piece with the frame or bed-plate, a shoulder 15 is provided between the elevated end of the magazine and the lowermost end of the runway, and a similar shoulder 16 is produced between the lowermost end of the magazine and the elevated end of the runway.

The setting-solenoid E is mounted within and insulated from a frame or hanger 17, which is secured firmly to the under side of the frame or bed-plate 12, so that the solenoid will lie at the lower or foot end of the inclined magazine 13 and adjacent to the shoulder 16 at the elevated end of the inclined runway 14. The restoring-solenoid F is similarly mounted in and insulated from a frame or hanger 18, which is secured firmly to the under side of the frame or bed-plate 12 and in a position for the solenoid F to lie adjacent to the foot end of the inclined runway 14 and to the shoulder 15 at the elevated end of the magazine 13. The coil of the setting-solenoid E envelops a non-magnetic brass tube 19, and in the upper part of this tube is loosely fitted a soft-iron plug 20, the latter being provided with an annular flange 21 at its upper portion, which is adapted to rest on the base or frame 12, as illustrated in Fig. 6, or preferably upon the top of the solenoid-frame, as shown in Fig. 8, in connection with the solenoid F. In the latter form the solenoid, with its movable parts, may be assembled in the hanger before the latter is secured within

the casing. Through a longitudinal passage in the plug 20 loosely passes the plunger 22 of a solenoid-core 23, which is adapted to be lifted when the solenoid is energized in a way to impart vertical movement to the plunger-rod 22. This plunger-rod is preferably made of brass or other non-magnetic material and is provided with a shouldered cap 24, of harder material, as steel, which is made tapering and presents concave surfaces for engagement with the weights which are employed in the signal-controlling mechanism. The cap is held out of engagement with the plug 20 in its lower position by reason of the fact that the core 23 rests upon the hanger-frame. It is important to proportion the parts in this manner, that the cap may not stick to the plunger by reason of the residual magnetism of the plunger. For a like reason a copper washer is placed on the top of the core, inasmuch as said core is limited in its upward movement by contact with the lower end of the plunger.

The restoring-solenoid F envelops a brass tube 25, in the upper part of which is loosely fitted a soft-iron plug 26, that is flanged to rest upon the solenoid frame or support 18, said plug having a longitudinal opening for the accommodation of a reduced plunger or stem 27 of a solenoid-core 28. The upper end of this core has a cap or head 29, which is similar to the cap 24 of the plunger associated with the setting-solenoid E; but the head or cap 29 of the plunger associated with the restoring-solenoid is arranged to play in the eye or opening 10 of the semaphore-arm 9, whereby the headed end of the plunger 28 is adapted to move through the eye of the semaphore-arm in a way to lift the rolling weight O, which is adapted to rest on the end of the semaphore-arm for the purpose of holding the semaphore in a raised displayed position, as indicated by Figs. 5 and 8 of the drawings.

Each signal-controlling device is provided with guards or guides 30 31, which are fastened to or made a part of the bed plate or frame 12. The guard 30 is arranged to overhang the space between the adjacent ends of the magazine 13 and the runway 14 in a way to limit the upward movement of the rolling weight O when the plunger 23 is lifted quickly by the action of the solenoid E, thus preventing one of the rolling weights from jumping out of place during the operation of lifting the weight from the lower end of the magazine 13 to the elevated end of the runway 14. The other guard, 31, overhangs the space between the lower end of the runway 14 and the elevated end of the magazine 13, thus preventing another of the rolling weights O from becoming displaced when the solenoid F becomes energized for the operation of the plunger 28 in lifting said rolling weight from the lower end of the runway 14 to the elevated end of the magazine 13, as will be readily understood.

The bed-plate or frame 12 is provided with a longitudinal slot 32, having an enlargement or eye 33 at one end and widened near its other end, as at 34. (See Fig. 7.) In the slot 32 is arranged to travel or play the bent arm of the semaphore, while the enlarged end portion 10 of the semaphore-arm is adapted to work in the opening 33, as shown by the drawings. The semaphore-arm carries an insulating-block 35, which projects upwardly into the widened end portion 34 of the slotted bed-plate or frame, and this insulating-block may be equipped with the members of one or more switches, said block being also adapted to separate the members of another circuit-switch, said switches being hereinafter described in detail in connection with the signal system.

In Fig. 1 of the drawings I have shown the post or column 6 as being equipped with the semaphores A C, which are adapted to be actuated by different signal-controlling devices, which are included in independent circuits, but are opened and closed by the trolley-wheels of cars which are adapted to travel in opposite directions on the same track. The semaphores A C are colored differently, and in Fig. 1 the semaphore A is adapted to serve as a danger-signal of one circuit, for which purpose it may be colored red, whereas the other semaphore, C, serves as a cautionary signal in another circuit, for which purpose it is colored green, the colorings of the two semaphores being differentiated by the shade-lines in Fig. 1. The signal-controlling devices associated with the two semaphores on the post or column 6 are identically the same in construction to that heretofore described, and represented by Figs. 6 to 8, inclusive, of the drawings, except that the signal-controlling device for the semaphore A is equipped with a plurality of rolling weights O, which correspond in number to the number of cars traveling in the same direction and adapted to be admitted successively to one block of the railway, whereas the signal-controlling device for the semaphore C should be equipped with two of the rolling weights, the same being indicated at O^3. As shown by said Fig. 1 of the drawings, the signal-controlling device for the cautionary semaphore C occupies an elevated or raised position above the controlling device for the danger-semaphore A, and I have shown the upper semaphore and its controlling device as being supported by a section 6^a of the post or column, said section 6^a being united in a suitable way to the casings 5 of the two signal-controlling devices for the respective semaphores.

In Figs. 2, 3, and 4 of the drawings I have shown a form of construction of the trolley-switch which is adapted for use in connection

with the improved signal system of my invention for the purpose of operation in connection with the trolley-wheel of a car in order to admit current from a trolley-conductor K into one of the semaphore-circuits of the signal system. A plurality of these trolley-switches is used in connection with the turnouts *k k'* of the overhead trolley-conductor K, and, as shown by Fig. 9, I employ four of these trolley-switches, the positions of which are indicated at L L' and M M'. Each trolley-switch, however, is constructed as disclosed by Figs. 2 to 4, inclusive, of the drawings and which I will now proceed to describe.

The switch includes in its construction a body 35, of non-conducting material, such as wood or any suitable substance, and the metallic end pieces 36, the same being provided with openings for the accommodation of the trolley-wire K, said wire passing continuously through one end piece 36, the non-conducting body 35, and the other end piece 36, as indicated by full and dotted lines in Fig. 2. On the under side of the body or bridge 35 of the trolley-switch are contact-rails 37 38, one of which is normally a live rail, whereas the other is a dead rail. The two rails are insulated electrically from the bridge 35 and the metallic end pieces 36 by suitable interposed insulation 39, the same having a tongue 40 filling the spaces between the depending flanges of the contact-rails, as shown more particularly by Fig. 4. On the bridge 35 are placed bridge-plates 41, which are bolted, as at 42, to have electrical contact with the metallic end pieces 36 and the live rail 38, whereas the dead rail 37 is fastened to the insulation by screws 43 and a bolt 43ª, said dead rail being insulated from the live rail and the charged parts of the bridge or trolley-switch. The contact-rails 37 38 lie on the under side of the bridge and in the path of a trolley-wheel Z in order that the wheel may pass from one part of the trolley-wire and an end member 36 of the bridge into engagement with the rails 37 38 for the purpose of completing the circuit through the two rails and of energizing the dead rail 37, so that the current required for the operation of the signal devices may be carried from the rail 37 and the bolt 43ª by suitable conductors, one of which is attached to the trolley bridge or switch by the nut and washer of the bolt 43ª, as shown by the drawings.

I will now proceed to describe the system illustrated diagrammatically by Fig. 9 of the drawings, wherein a trolley contact-switch L is adapted for closing one of the electrical circuits when a car travels into the block in the direction of the arrow *m*. From the trolley-switch L leads a conductor 45, which extends from the entrance-point of the block to a distant signal, herein shown as the danger-semaphore A, said conductor 45 being in circuit with the setting-solenoid E, the latter having a ground or return connection 46. By energizing this setting-solenoid E the plunger thereof is lifted for the purpose of elevating a weight O from the magazine 13 and depositing it upon the runway 14, along which the weight is adapted to roll, so that it will strike against the arm 9 of the semaphore A and depress said arm for the purpose of raising the semaphore A to the displayed position, which will indicate "danger," as indicated by full lines in Fig. 9. The action of the weight O when imposed on the arm of the semaphore holds it directly over the plunger of the resetting-solenoid F, whereby it may be removed when said solenoid becomes energized. The insulated arm of the semaphore A is equipped with switches 47 48, which are adapted to engage with contacts 49 and 50, respectively, when the semaphore is in its horizontal position.

From one contact 50 of the switch 48 leads a conductor 51, which is attached directly to the turnout *k'* of the trolley-wire K, and from the other contact 50 of the switch 48, associated with the distant danger-semaphore A, leads another conductor, 52, which extends back along the track of the entrance-point to the block, said conductor 52 being attached to a setting-solenoid G, associated with the cautionary semaphore B at the point of entrance to the block. From the setting-solenoid G leads a conductor 53 to one contact 54 of a switch 55, said switch in the normal lowered position of the entrance cautionary semaphore B making engagement with the switch-contact 54, so as to normally close the circuit, one conductor, 56, of which leads to one contact 57 of a switch 58 on the arm 35 of the semaphore D. From the other contact 57 of the switch 58 leads a conductor 59, having a return connection 60. It is to be understood that in Fig. 9 I have shown the semaphores A B in their displayed raised positions for the purpose of warning a car traveling in the opposite direction to that indicated by the arrow *m* that the block is occupied, whereas the cautionary semaphore B at the entrance to the block is also displayed to warn a car following that in the block of the occupancy of said block; but when the block is unoccupied the two semaphores A B will fall to the lowered safety positions, wherein the switch 48 will open the circuit between the contacts 50 of the live wires 51 52, while the switch 55 will close the circuit between the contacts 54 of the conductors 53 56.

It is to be understood that a car traveling in the direction of the arrow *m* closes the trolley-switch L for the admission of current through the conductor 45 to the solenoid E, thereby elevating the plunger of said solenoid and lifting one rolling weight O from the magazine 13 of the semaphore-controlling device onto the runway 14, down which the weight rolls until it strikes the bent arm of

the semaphore A, thereby turning the latter on its pivot and moving it to a horizontal displayed position, whereby the distant semaphore A will be immediately displayed when the car enters the block. The movement of this semaphore makes the switch 48 engage the contacts 50 and admit current from the trolley-wire through the live wire 51, across the switch 48, into the wire 52, through the solenoid G, associated with the entrance-semaphore B, the current finding a return connection through the conductor 53, the contacts 54, the switch 55, the conductor 56, the switch 58 and its contacts 57, and the return-wire 60. By energizing the solenoid G its plunger is raised and a weight O′ is lifted from the magazine 13 to the runway 14 in a way to operate on the arm of the semaphore B, thereby turning the semaphore to a displayed position and causing the arm 35 to move the switch 55 from the contacts 54, thus opening the circuit through the live wire 51, the weights O and O′ being effective in holding the semaphores A B in their raised positions and over the restoring-magnets F H, which are provided in the two signal-controlling devices that are associated with the semaphores A B.

From the contact 49, associated with the switch 47 on the distant semaphore A, leads a conductor 61, which has a return connection through the wire 46, while another conductor, 62, leads from the other contact 49 of the switch 47 to the restoring-solenoid F, said conductor 62 running directly to a wire 63, which is attached to the trolley-switch L′, that is located at the point of departure from the block and adjacent to the turnout *k′* of the trolley-conductor K. This wire 63 extends from its point of connection with the wire 62 of the restoring-solenoid F, associated with the distant semaphore A, to a wire 64, the latter having connection with a conductor 65, that includes the restoring-solenoid H, associated with the entrance-semaphore B, said wire 65 leading to one of the pair of contacts 66. From the other contact of the pair leads a wire 67, having a return connection through the return-wire 60. The contacts 66 are adapted to be bridged by the switch 55 when the semaphore B is moved to its raised position by the imposition of the weight O′ on the semaphore-arm, and the circuits through the solenoids F and H of the distance and entrance semaphores are thus completed from the departure trolley-switch L′.

Assuming that the semaphores A B have been raised to their displayed positions by a car entering the block and that the parts take the positions shown by Fig. 9, the two semaphores are adapted to be turned simultaneously to their safety positions when the car leaves the block. The engagement of the trolley-wheel with the switch L′ of the turnout *k′* diverts the current from the trolley-wire through the conductor 63, the current dividing at the point where the conductor 62 joins with the conductor 63. A part of the current passes through the conductor 62, the solenoid F, the contacts 49, the switch 47, and the return connections 61 46, thereby lifting the plunger of the solenoid F to raise the weight O upon the inclined magazine 13, whereby the distant semaphore A is released from the weight, and it is free to drop to its safety position. At the same time another part of the current from the trolley-switch L′ flows through the conductors 63 64 to the solenoid H, thence across the conductor 65, the contacts 66, the switch 55, and the return connections 67 60, whereupon the plunger of the solenoid H is raised to lift the weight O′ from engagement with the arm of the semaphore B, thus placing the rolling weight O′ upon the runway 14 and allowing the semaphore B to drop to its safety position. The return of the semaphore B to safety position opens the circuit through the conductors 63 67, because the switch 55 moves from the contacts 66 over to and in engagement with the contacts 54 in the circuit which includes the conductors 53 56, and similarly the return of the semaphore A to its safety position moves the switches 47 48 away from engagement with the contacts 49 50, thus opening the circuit through the solenoid F and the conductors 51 52. During this movement of the semaphore and the switches the switch 48 is adapted to engage with the contacts 68, from one of which leads a conductor 69, that is attached to a return connection 70, the latter being attached to the return-wire 46. This return connection 70 extends to one contact, 71, of a pair associated with the semaphore C, and from the other contact, 68, leads a conductor 72, which extends to another contact, 73, of a pair also associated with the semaphore C. The other circuit, for operation by a car traveling in the opposite direction, as indicated by the arrow *n*, includes the distant semaphore D and the entrance-semaphore C, together with signal-controlling devices for operating said semaphores, the said signal-controlling devices being constructed substantially as represented by Figs. 5 to 8, inclusive, and heretofore described. From the entrance trolley-contact M leads a conductor 74, which is connected with a setting-solenoid E′, associated with the distant semaphore D, said solenoid E′ having a return-wire 75. This solenoid when energized operates the plunger thereof to lift one of the rolling weights O² upon an inclined runway similar to the devices heretofore described, and this rolling weight actuates to depress the arm of the semaphore D, thereby moving the latter to a displayed position and into coöperative relation to the restoring-solenoid F, the latter being adjacent

to the solenoid E′ and adapted to coöperate with the semaphore D and one of the rolling weights O^2 for the purpose of restoring the semaphore D on the departure of the car from the block, as will be hereinafter described.

The movement of the semaphore D operates to shift the switch 58 from the contacts 57 and to open the first-named circuit, said switch 58 engaging with the set of contacts 76, so as to bring into service the live wire 77, the latter having direct connection with the trolley-wire K. From the other contact of the set 76 leads a wire 78, which has a branch connection with the solenoid G, associated with the semaphore B, and the current admitted by the live wire 77 is adapted to bridge the space between the contacts 76 through the switch 58 and pass through the conductor 78, a part of the conductor 52, to and through a conductor 79, which leads to the solenoid I, that is associated with the departure-semaphore C, said solenoid I having a conductor 80, which leads to the contacts 73, thus allowing the current to pass through the switch 81 and by the wire 72, the contacts 68, and the switch 48 through the wire 69 to the return connections 70 46. It will thus be seen that on the entrance of a car into the block from the left the distant semaphore D will first be set to a displayed danger position and will operate to close the circuits in a way to admit the current through the live wire 77 and the described connections to the setting-solenoid I, which will actuate one of the rolling weights O^3 in a way to set the entrance-semaphore C to the displayed position, because the current will energize the solenoid I to move its plunger upwardly and raise one of the weights O^3 to an inclined runway of the signal-controlling device, which weight will engage with the semaphore-arm C, and thus move the latter to the elevated displayed position for giving a cautionary warning-signal to a car following the first car and moving in the direction of the arrow *n*.

When the semaphores D and C are raised, the restoring-solenoids are brought into the circuit by the operation of the switches 82 81, which are associated with the respective solenoids, such switch 82 being adapted to make the contacts 83, while the switch 81 makes the contacts 71. From the departure-contact M′, which, with the entrance-contact M, forms one set for the car moving in the direction of the arrow *n*, leads the conductor 64, which is connected with the restoring-solenoid F′ of the distant semaphore, and from this solenoid leads a wire 85, that is attached to one of the contacts 83. The other contact 83 has a conductor 86 attached thereto and constituting a return connection through the wire 60. From the conductor 64 leads the wire 63, which has the conductor 62 attached thereto, said conductor 62 having a branch connection 87 to the restoring-solenoid J of the entrance-semaphore C, and from this solenoid J leads a conductor 88, which is attached to one of the contacts 71. It will be understood that the switch 82 will close the return connection from the solenoid F′ by making the contacts 83 when the semaphore D is moved to a displayed position. The movement of the semaphore C to a displayed position causes the switch 81 to make the contacts 71, and the solenoid J is included in the circuit with the departure trolley-switch M′ by the conductors 63 62 87 and has a return connection to the conductor 88, the contacts 71, the switch 81, and a return-wire 89, which leads from one of the contacts 71 to the return-wires 70 46. After the semaphores C D shall have been moved to their displayed positions the car in leaving the block engages the trolley-switch M′, thus admitting current to the conductor 64. A part of the current passes through the conductor 64, the solenoid F′, the wire 85, the contacts 83, the switch 82, and the wire 86 to the return-wire 60, whereby the plunger of the solenoid F′ is operated for lifting the weight from the arm of the semaphore D, so as to allow the latter to return by gravity to an inclined safety position. At the same time a part of the current passes from the wire 64 through the wires 63, 62, and 87 to the solenoid J, from whence it passes through the wire 88, the contacts 71, and the return-wires 89, 70, and 46, thus operating the plunger of the solenoid J to lift one of the rolling weights O^3 away from the arm of the semaphore C and allow the latter to return by gravity to normal position.

It will be seen that in each circuit the distant semaphore is first moved to a displayed position and the entrance-semaphore is thereafter displayed when a car enters a block; but when the car leaves the block the current takes a divided course for operating the controlling devices of the two semaphores simultaneously, thus moving both semaphores to their safety positions.

An important feature of my invention consists in the provision of means forming parts of the signal-setting devices in each of the circuits whereby a number of cars moving in the same direction may be admitted to the block without restoring the semaphores, either distance or entrance, to their safety positions. This is accomplished by the employment of rolling weights, corresponding in number to the cars to be admitted to the block, in connection with the setting-solenoids E E′ of the signal-controlling devices associated with the danger-semaphores A D. Assuming that a car enters the block from the right and in the direction of the arrow *m*, the plunger of the solenoid E is operated to raise one of the weights O and set the semaphore A, after which the semaphore B of the entrance-signal is displayed. This allows another rolling

weight from the magazine associated with the setting-solenoid E to assume a position over the plunger thereof, and in like manner a rolling weight O′ takes position over the plunger of the solenoid G, both of the semaphores A and B being displayed. When the second car passes the trolley-switch L, the solenoid E is again actuated, so that the plunger of the solenoid E will lift another weight on to the inclined runway 14, thus placing a second weight on the runway adjacent to the arm of the semaphore A. This operation is repeated until the desired number of cars have entered the block and a corresponding number of weights have been placed upon the runway. The entrance-semaphore is unaffected by the cars succeeding the first, as the circuit through the actuating-solenoid G is broken at the contacts 54, and accordingly the semaphore remains in the displayed position. When a car leaves the block connecting the switch L′ with the supply-main, the solenoids F and H are operated in the described manner to remove a weight from the arms of the respective solenoids, and in the case of the solenoid F this takes place each time a car leaves the block until all have been returned to the magazine, the arm A being held in the displayed position until the last weight has been removed. On the other hand, since only one weight has been placed upon the entrance-semaphore B it is released with each departing car by the action of the solenoid H and falls by gravity to the lower position. This immediately closes the contacts 54 through the switch 55, thereby closing the circuit through the solenoid G to raise a weight O′ into the runway, and thereby again raise the semaphore to the displayed position, and this occurs successively with the departure of each car until the last one. As the last car passes onto the switch L′ the weight O′ is lifted from the arm B and the last weight O is lifted from the arm A, the arms, however, being still maintained in horizontal position by reason of the engagement of the plungers with the inner side of the ring-shaped ends of the semaphore-arms after a very slight downward movement of said arms. This has the effect of preventing the closure of the circuit 53 at the contact-points 54, and accordingly the arms A and B will fall simultaneously to the position of "safety" when the trolley of the last car passes from the switch L′, indicating that the track is clear.

The heads or caps on the ends of the solenoid-plungers are preferably made of steel in order to keep the brass stems from mutilation when they are brought forcibly into contact with the rolling weights in the operation of lifting them from the magazines to the runways, or vice versa. These heads or caps are so shaped and set on the stems that when there is more than one rolling weight in the rack and when one of the weights has been elevated from one rack to the other of the same set the second weight rolls down and comes in contact with the upper edge of the rim of the cap or head, thereby having a tendency to push the solenoid-plunger in a downward direction rather than to bind it within the solenoid.

The employment of the eye in the end of the semaphore-arm is advantageous for this reason: Assuming that a car enters the block, the eye-formed end of the arms on the danger and cautionary semaphores will be weighted down. As the car passes out of the block the restoring-magnets of one circuit are energized at the same time, and with both the semaphores in their raised positions, the weights having been removed by the plungers, the ends of the arms fall slightly and engage the plungers, so that they are prevented from falling by gravity until the solenoids are deënergized by the passing of the trolley-wheel of the car from the switch L′ or M′, when the plungers drop through the eyes of the semaphore-arms and permit the semaphores to drop by gravity to their inclined positions.

I attach importance to the employment of the solenoids having the plugs set loosely therein, because of the facility with which they may be removed in case it is desired to examine the operative parts of the core. No securing means is necessary even when they are struck by the upward blow of the core on account of the magnetic attraction of the solenoid tending to draw them downward. These plugs of magnetic material have a tendency to quicken the action of the solenoid by extending them into the holes of said solenoids in a way to present a magnetized iron surface to the end of the solenoid-core, and when the current is applied these plugs are magnetized and assist the solenoids in attracting the cores, thus causing them to act very quickly.

I do not intend to confine the use of my improvements in connection with a semaphore which denotes "safety" when lowered to an inclined position or gives a warning-signal when raised to a horizontal position, because I am aware that by using these devices in circuits which are connected differently from the circuits herein described the semaphores may be made to indicate "safety" when raised to horizontal positions and to give the warning-signals when lowered to inclined positions, thus reversing the operation of the semaphores.

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

1. In an electric railway-signal, a signal-controlling device having oppositely-inclined runways, a signal, a rolling weight operatively related to the signal, and means for raising the weight from its operative position.

2. In an electric railway-signal, a signal-

controlling device including a magazine and a runway, means for transferring rolling weights from one part to the other, a semaphore in coöperative relation to the rolling weights, and means for raising the weight from coöperation with the semaphore.

3. In an electric railway-signal, a signal-controlling device having a magazine and a runway, a plurality of rolling weights adapted to traverse the magazine and the runway, a semaphore in coöperative relation to the rolling weights, and electrically-actuated devices for transferring a rolling weight from one part to the other of the signal-controlling device.

4. In an electric railway-signal, a signal-controlling device having an inclined magazine, a runway inclined oppositely to the magazine, electrically-controlled devices in coöperative relation to the magazine and the runway, rolling weights adapted to traverse said magazine and the runway and to be actuated by the electrically-controlled devices, and a semaphore having means disposed in the path of the rolling weights for actuation thereby.

5. In an electric railway-signal, the combination with a semaphore, of a shiftable weight adapted to be imposed on the semaphore for moving the same to an abnormal position and for holding the semaphore in said abnormal position without the employment of locking devices, and circuit-controlled means for shifting the weight.

6. An electric railway-signal having a semaphore provided with an eye-formed arm, a rolling weight arranged to be imposed upon said arm, and a plunger adapted to play through the eye of the arm and to act against the weight.

7. An electric railway-signal having a semaphore, a shiftable weight adapted to be imposed on said semaphore, and a plunger acting against said shiftable weight to lift the same from the arm of the semaphore.

8. An electric railway-signal, having a semaphore, a magazine, a plunger coöperating with said magazine, a plurality of weights contained in the magazine and adapted for actuation by the plunger, a runway adjacent to the magazine in which the weights act upon the semaphore, and another plunger coöperating with the runway and adapted to transfer weights from said runway back to the magazine.

9. An electric railway-signal having a magazine and a runway, shiftable weights adapted to be contained in said magazine or the runway, devices for transferring the shiftable weights from one part to the other, means for limiting the movement of the shiftable weights when actuated by the transferring devices, and a semaphore adapted to be controlled by the weights upon discharge from the runway.

10. An electric railway-signal having a semaphore, a weight adapted to be imposed thereon, a solenoid, a plunger controllable by the solenoid, and a plug fitted loosely in the solenoid and presenting a surface in coöperative relation to the solenoid-plunger.

11. An electric railway-signal having a semaphore, a weight imposable thereon, a solenoid, and a plunger controllable by the solenoid and having a headed end adapted for engagement with said weight.

12. An electric railway-signal having a semaphore, a weight imposable thereon, a solenoid, a plug fitting loosely in the solenoid, and a core or plunger controllable by the solenoid passing through the plug and having a head exposed for engagement with the weight.

13. An electric railway-signal having a semaphore, a weight imposable thereon, a solenoid, and a core controllable by the solenoid, said core having a curved head adapted for engagement with the weight.

14. In an electric signal, mechanism for actuating the same, comprising a solenoid-coil adapted to be connected to an electric circuit, a plug having a longitudinal bore and provided with a flange fitted loosely in the coil, a core arranged to reciprocate in the coil and provided with a plunger adapted to pass through said longitudinal bore, a cap on the outer end of said plunger, and a supporting-frame surrounding the coil, arranged to support the plug and core respectively above and below the coil.

15. In a railway-signal, the combination with a semaphore adapted to move into different positions, a movable weight for controlling one of said positions, and electromagnetic means for moving of said weight.

16. An automatic signal system comprising a distant signal, an entrance-signal and controlling devices for each signal, the controlling device for the distant signal including means for successively preparing for coöperation therewith a plurality of actuating devices for each number of cars admitted into a block, and for successively removing said devices from cooperation when the cars leave the block.

17. In a railway-signal, the combination with a semaphore adapted to indicate safety or danger by different positions thereof, of gravity-controlled means for determining said positions, and electromagnetic means for controlling said gravity-controlled means.

18. In an automatic signaling system, the combination of a supply-main, a circuit adapted to be connected therewith, including a signal-controlling magnet, a signal-arm operated thereby, having a switch-blade connected thereto, a second circuit connected to the supply-main, including a signal-controlling magnet, and switch-contacts adapted to coöperate with said switch-blade, and a return-main connected to said circuits.

19. In an electric railway, the combination with supply-mains connected to a source of electric energy, of a switch adapted to be placed in circuit therewith through a trolley operating thereon, a circuit connected with

said switch, including the operating-magnet of a signaling device, a second circuit connected to the supply-conductor, including the operating-magnet of a signaling device and controlled by the movement of the first-named signaling device, a second switch adapted to be placed in circuit with the supply-mains upon the passage of said trolley thereover, having a circuit connected therewith including restoring-magnets for said signaling devices, and switches operated respectively by the signaling devices.

20. In combination with a railway having the track divided into block-sections with a double track or turnout at the terminals of each section, of electric supply and return mains coöperating therewith, having a divided conductor at each block-terminal whose branches correspond with the branches of each turnout of the track, switches located in proximity to each branch conductor, adapted to be placed in electrical connection therewith upon the passage of a car-trolley thereover, and circuits connected with said switches and the return-main, each including a magnet in operative relation with a signaling device, said magnets being arranged in pairs for controlling the operation and release of a signaling device and connected respectively in circuit with a switch at the opposite terminals of a block-section.

21. In combination with a railway having the track divided into block-sections with a double track or turnout at the terminals of each section, of electric supply and return mains coöperating therewith, having a divided conductor at each block-terminal whose branches correspond with the branches of each turnout of the track, switches located in proximity to each branch conductor, adapted to be placed in electrical connection therewith upon the passage of a car-trolley thereover, circuits connected with said switches and the return-main, each including a magnet in operative relation with a signaling device, said magnets being arranged in pairs for controlling the operation and release of a signaling device and connected respectively in circuit with a switch at the opposite terminals of a block-section, auxiliary circuits connected to said supply-mains, each including the actuating-magnet of a signaling device, and a circuit-closer operated by the movement of the first-named signaling device.

22. An automatic signal system, comprising a distant semaphore, an entrance-semaphore, and electrically-actuated signal-controlling devices for each semaphore; the controlling device for the distant semaphore including means for imposing a plurality of weights on said semaphore for each number of cars admitted into a block, and for successively removing the weights when the cars leave the block.

23. An automatic signal system, comprising a distant semaphore, an entrance-semaphore, and electrically-actuated signal-controlling devices for each semaphore; the controlling devices for the two semaphores including means for successively imposing weights on the distant and entrance semaphores, said weights being effective in holding the semaphores in displayed positions, and said controlling devices also including means for removing the weights simultaneously from the two semaphores.

24. An automatic signal system, comprising a distant semaphore, an entrance-semaphore, and electrically-actuated signal-controlling devices for each semaphore; the controlling device for the distant semaphore including means for imposing a weight on said distant semaphore each time one of a given number of cars may enter a block, and said distant semaphore closing a circuit which controls the device for imposing a weight on the entrance-semaphore, said devices also including means for removing the weights from both semaphores when a car leaves a block.

25. An automatic signal system, having distant and entrance semaphores, a setting-solenoid in circuit with an entrance trolley-switch, means actuated by said solenoid for moving the distant semaphore to a displayed position, a setting-solenoid associated with means for moving the entrance-semaphore to a displayed position, a switch controllable by the distant semaphore for placing the setting-solenoid of the entrance-semaphore in a charged circuit, another switch controllable by the entrance-semaphore for opening the circuit, and a departure trolley-switch in circuit with restoring-solenoids for the two semaphores.

26. An automatic signal system having distant and entrance semaphores, a setting-circuit including a trolley-switch and setting-solenoids which coöperate with shiftable weights for successively moving the distant and entrance semaphores to displayed positions each time one of a given number of cars enters a block, switches controllable by the semaphores for opening the setting-circuit subsequent to the display of the semaphores, and a restoring-circuit including a departure trolley-contact and setting-solenoids for removing the weights from the semaphores.

27. An automatic signal system having distant and entrance semaphores, a setting-circuit including an entrance trolley-contact and setting devices for imposing weights on the semaphores on the entrance of each of a number of cars into a block, and a restoring-circuit including a departure trolley-switch and restoring devices for removing the weights on the departure of cars from the block.

28. An automatic signal system comprising a distant semaphore, an entrance-semaphore, an electrically-actuated signal-controlling de-

vice for each semaphore, the controlling device for the entrance-semaphore including means for imposing a weight on said semaphore for each number of cars admitted into a block and for successively removing and replacing the weight when the cars leave the block.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM S. JACKSON.

Witnesses:

JNO. M. RITTER,

F. W. HANAFORD.