No. 762,331. PATENTED JUNE 14, 1904.

W. D. MARKS.

ELECTRIC SIGNAL.

APPLICATION FILED MAR. 12, 1903.

NO MODEL. 7 SHEETS—SHEET 1.

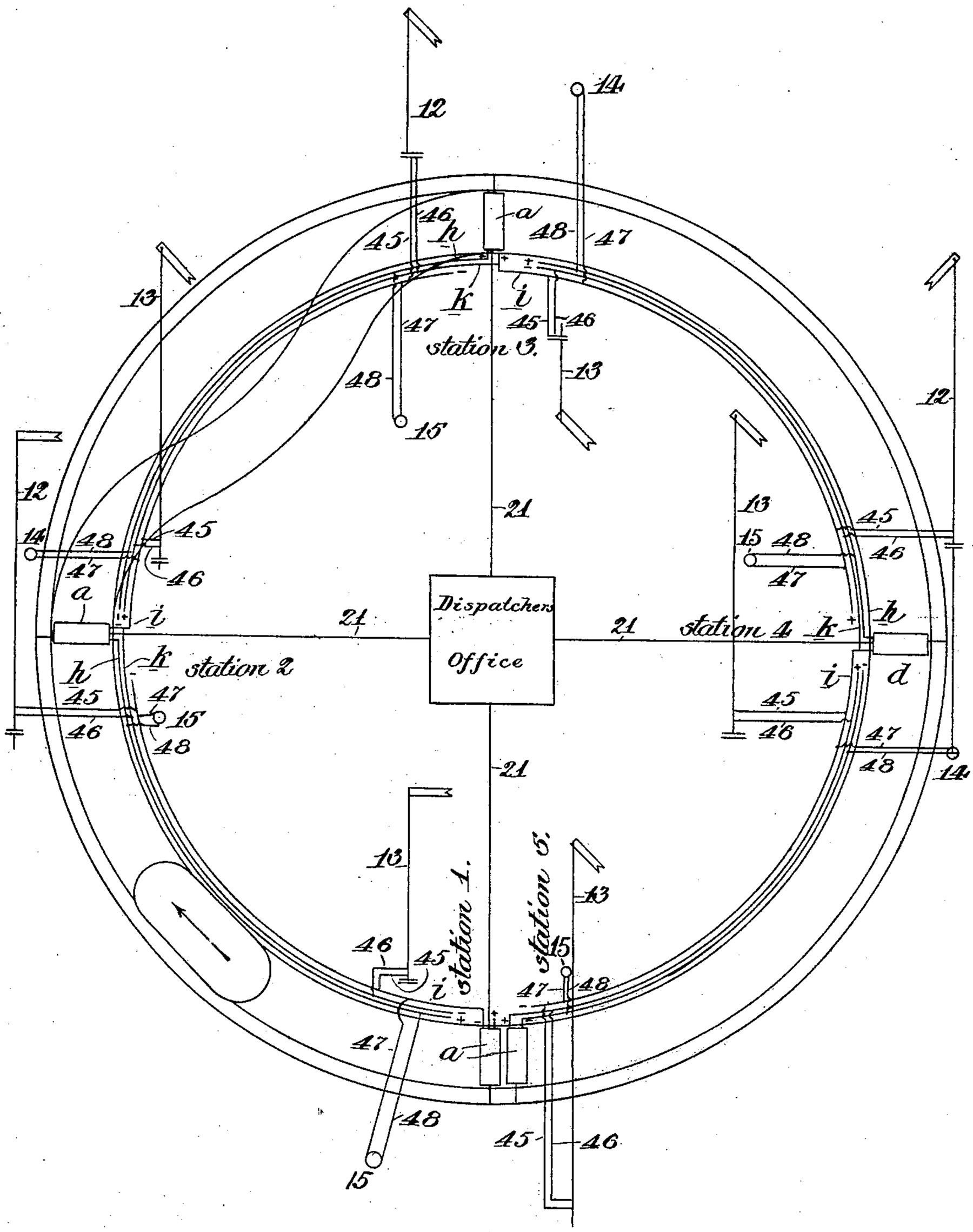

FIG. 1.

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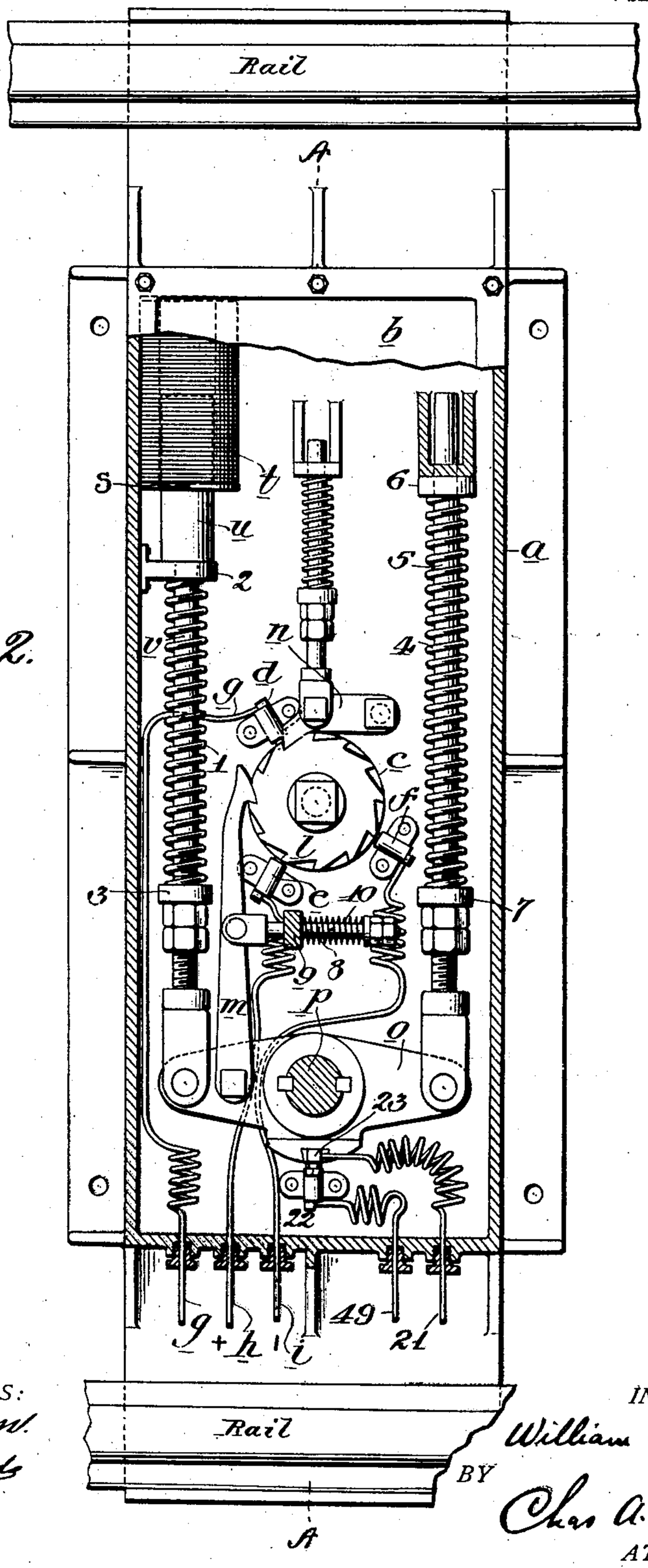
NO MODEL. 7 SHEETS—SHEET 2.

FIG. 2.



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NO MODEL. 7 SHEETS—SHEET 3.

FIG. 4.

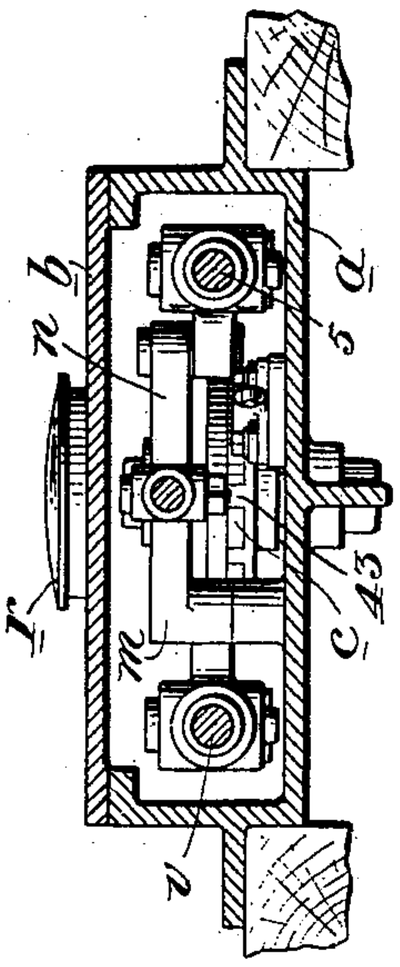


FIG. 3.

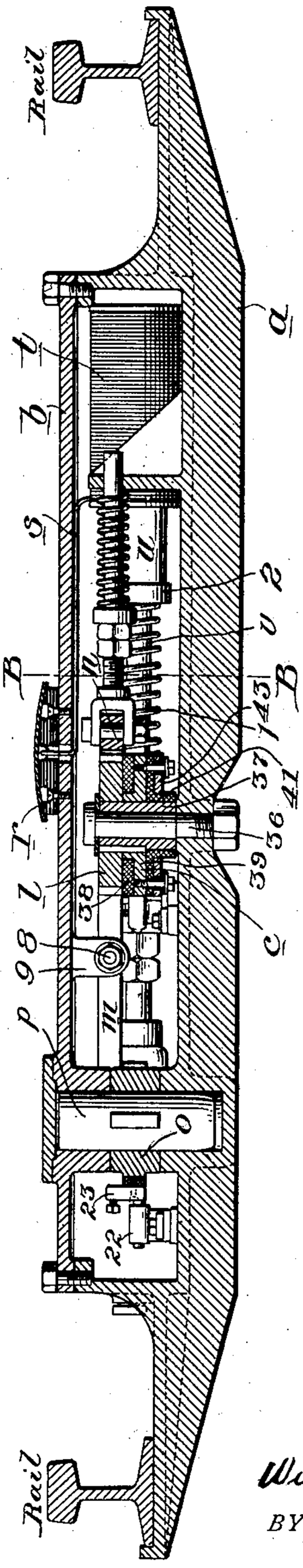


FIG. 8.

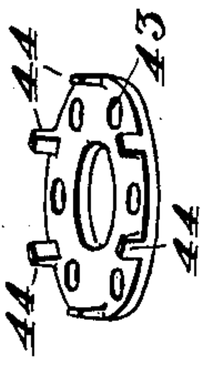


FIG. 7.

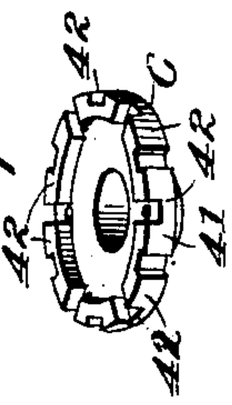


FIG. 6.

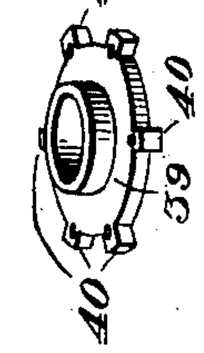
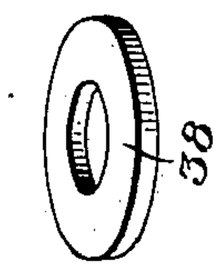


FIG. 5.



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NO MODEL. 7 SHEETS—SHEET 4.

FIG. 9.

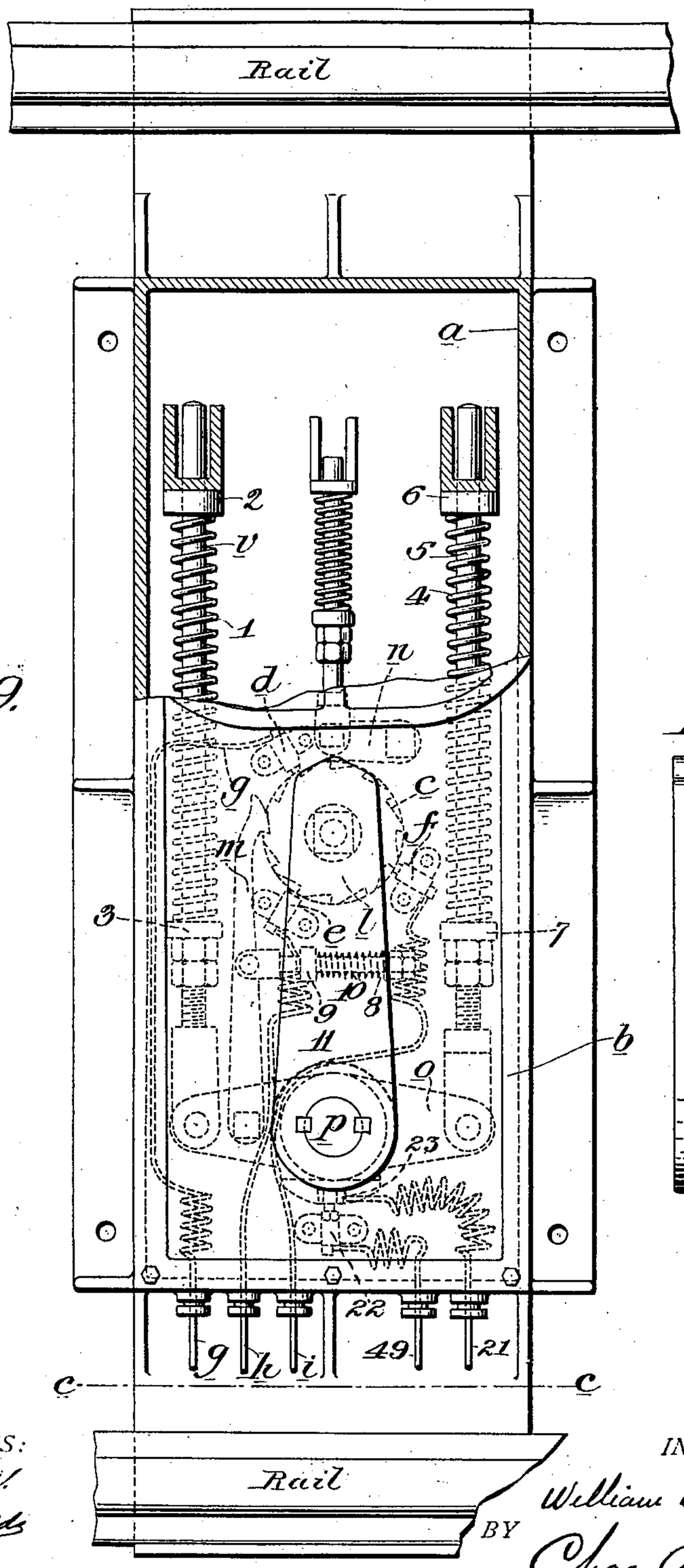
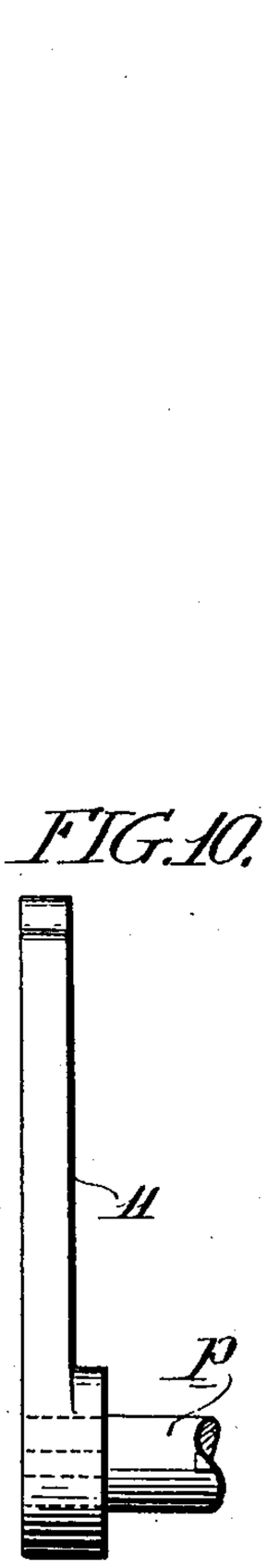


FIG. 10.



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APPLICATION FILED MAR. 12, 1903.

NO MODEL. 7 SHEETS—SHEET 5.

Fig. 11.

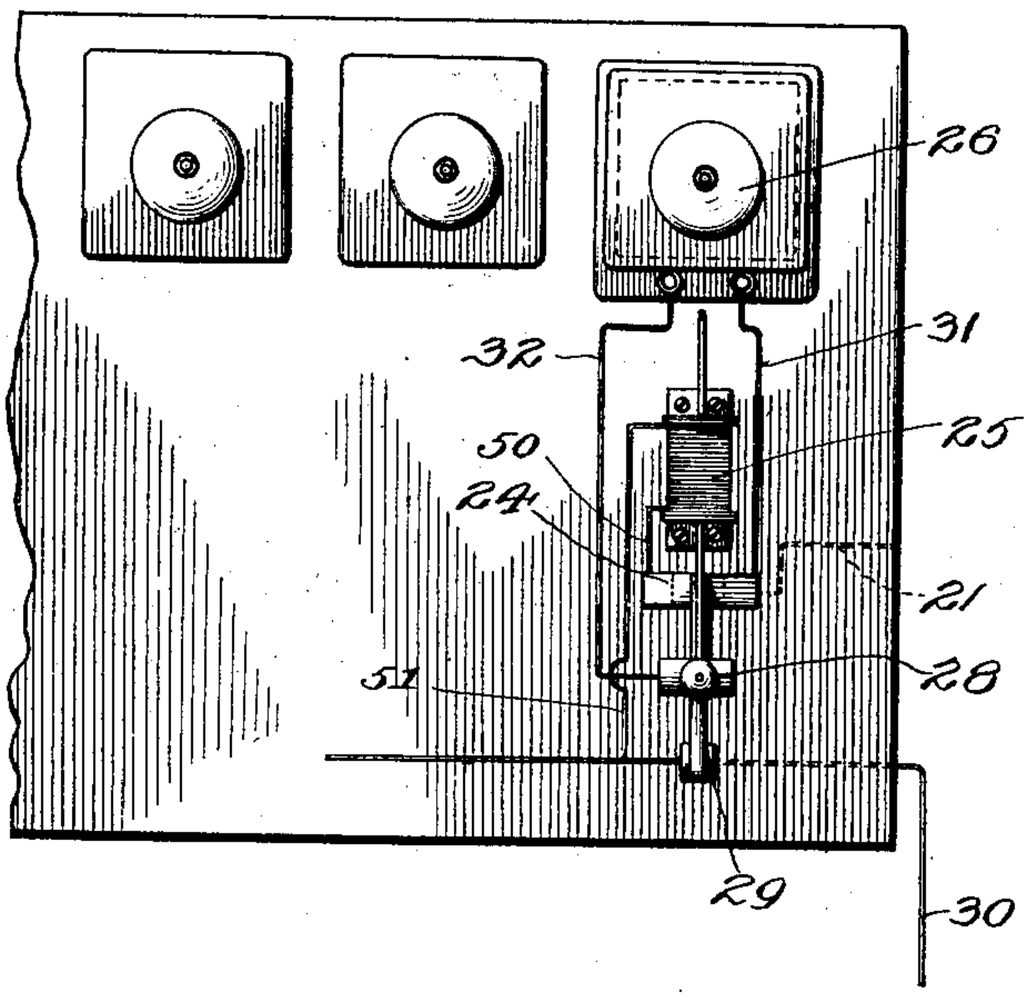


Fig. 12.

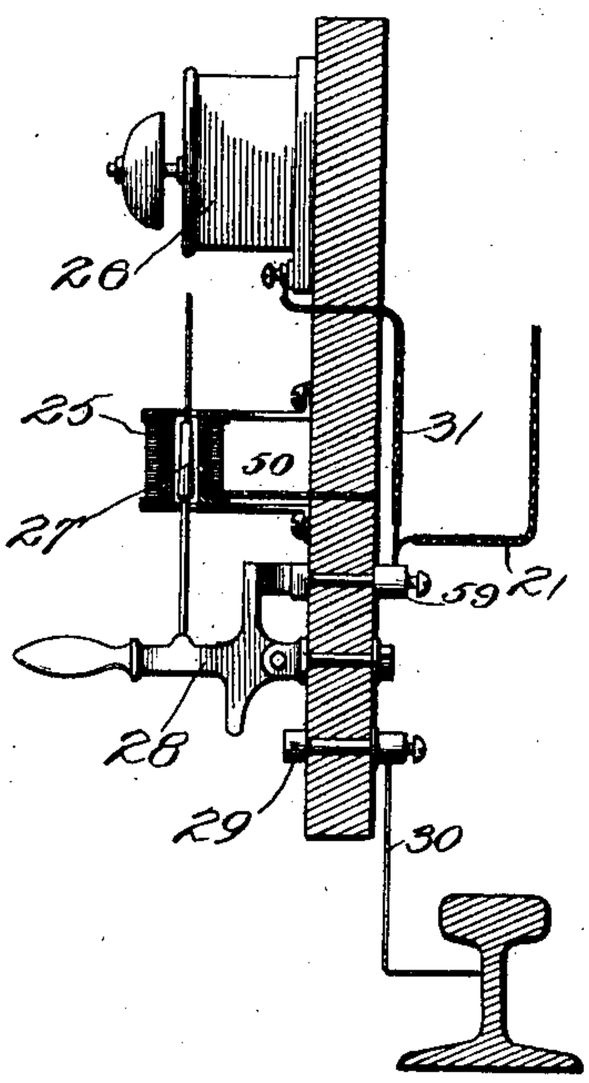
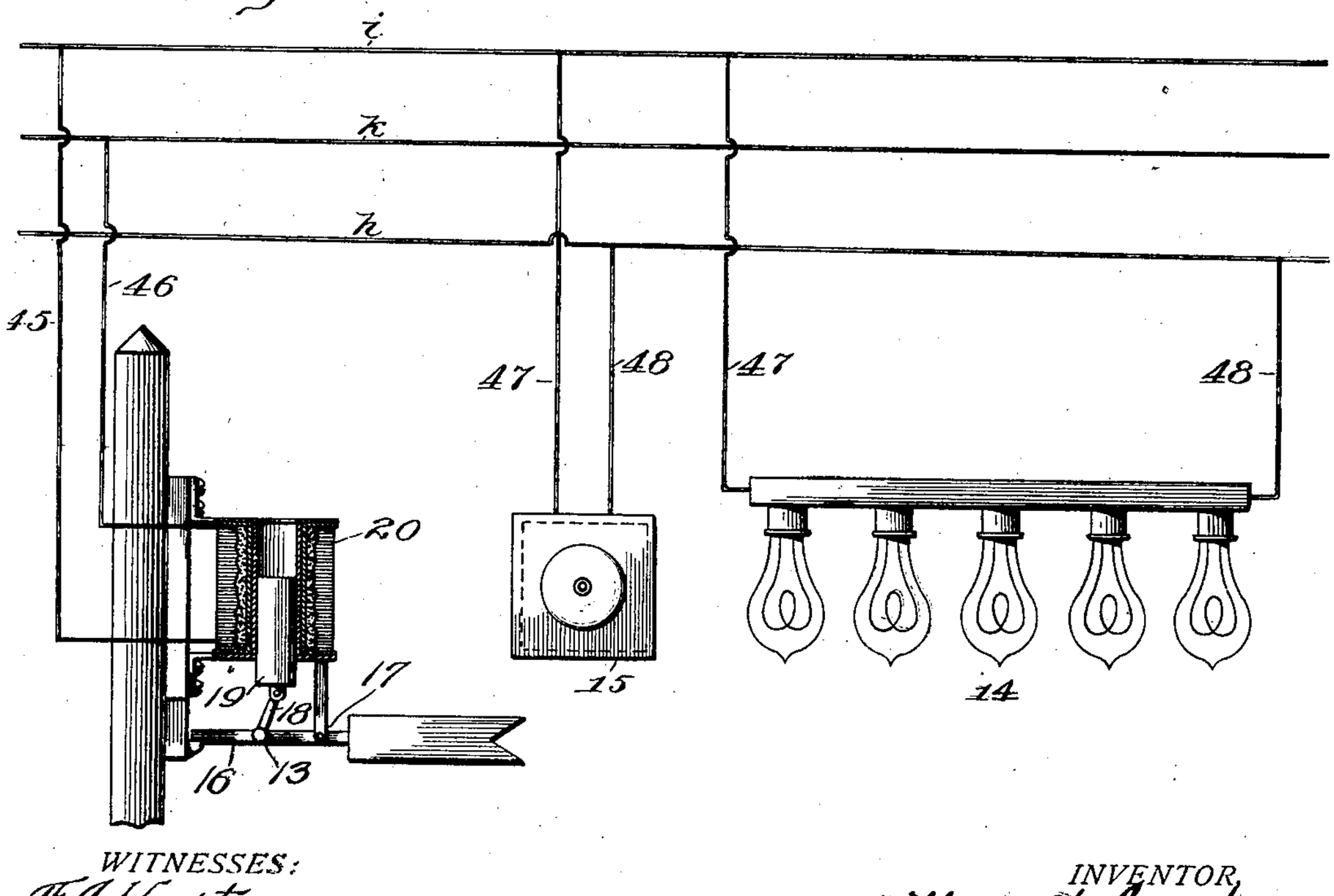


Fig. 13.



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APPLICATION FILED MAR. 12, 1903.

NO MODEL. 7 SHEETS—SHEET 6.

Fig. 14.

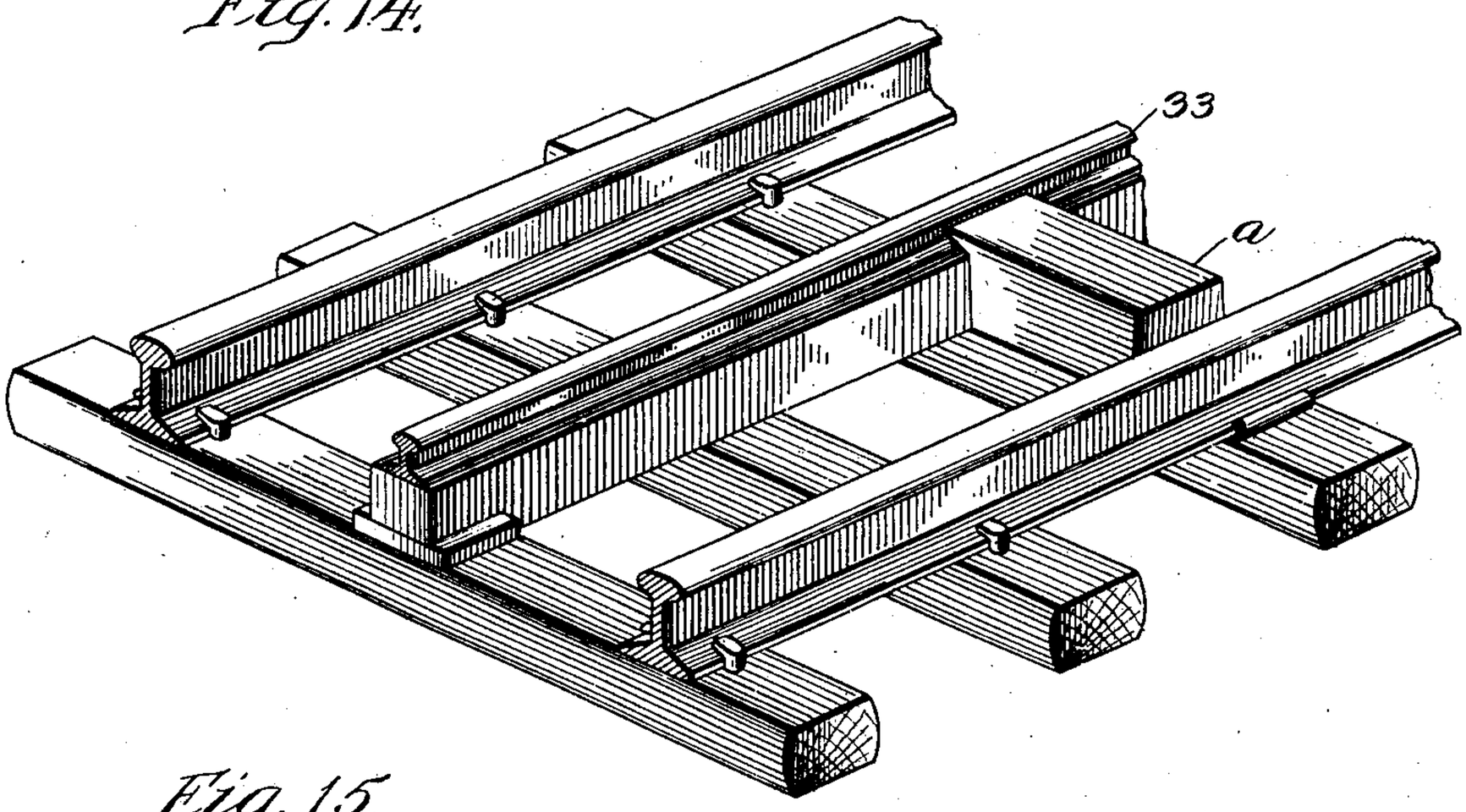
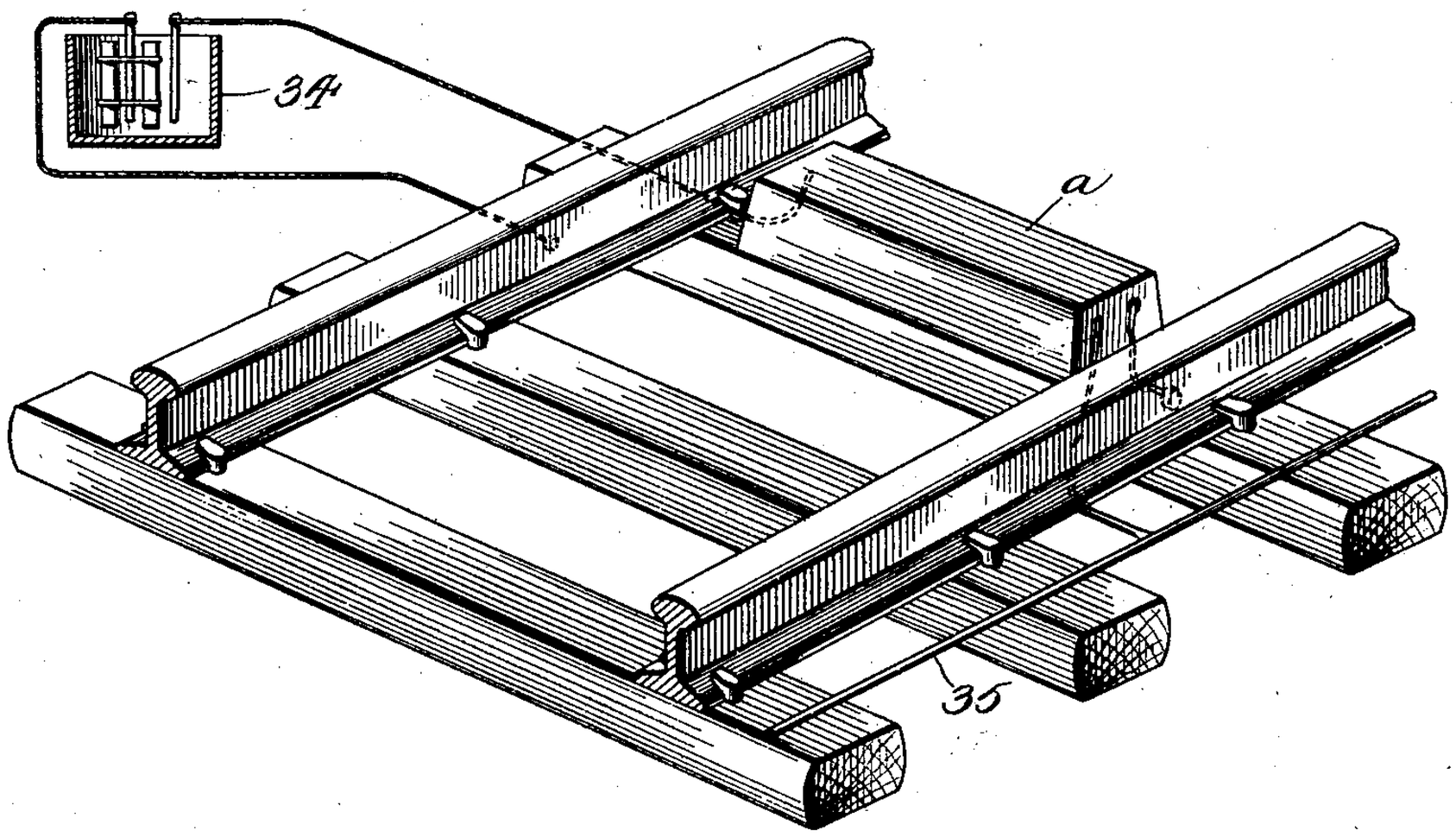


Fig. 15.



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APPLICATION FILED MAR. 12, 1903.

NO MODEL. 7 SHEETS—SHEET 7.

Fig. 16.

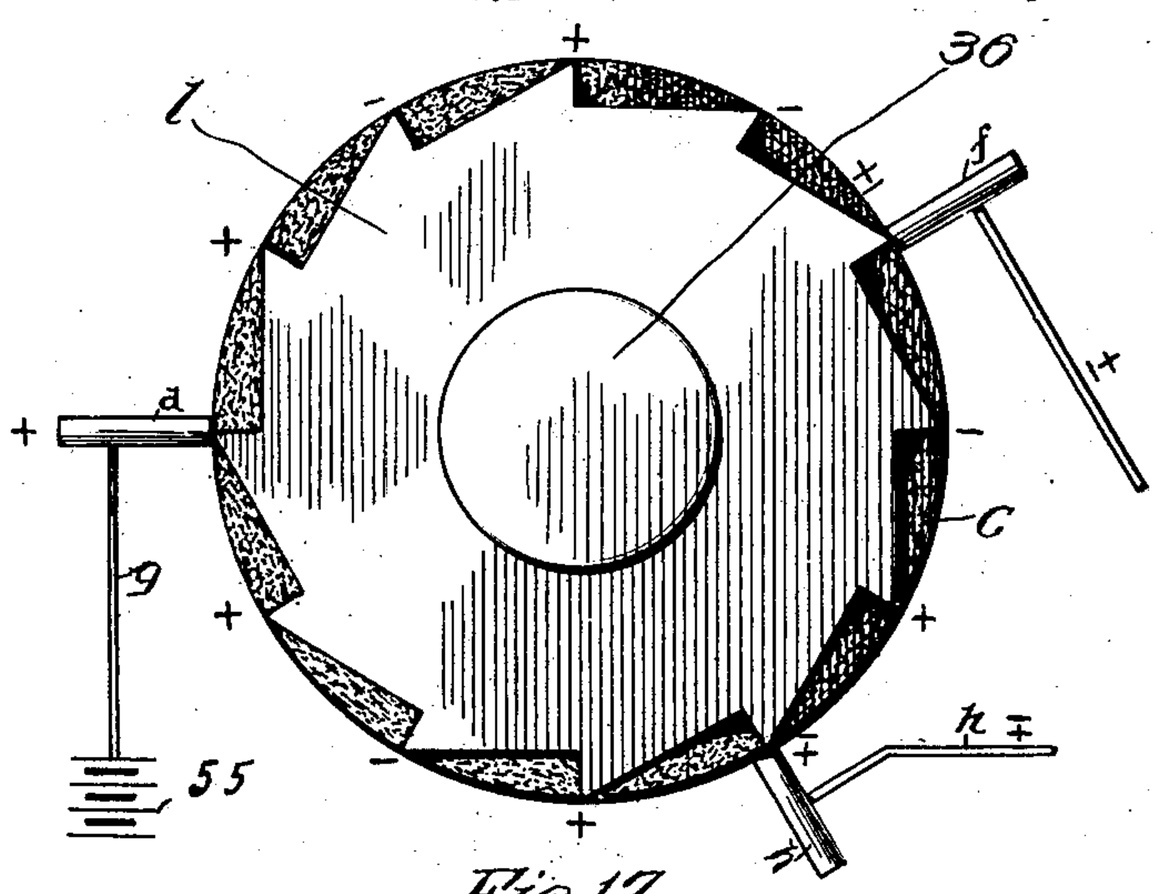


Fig. 17.

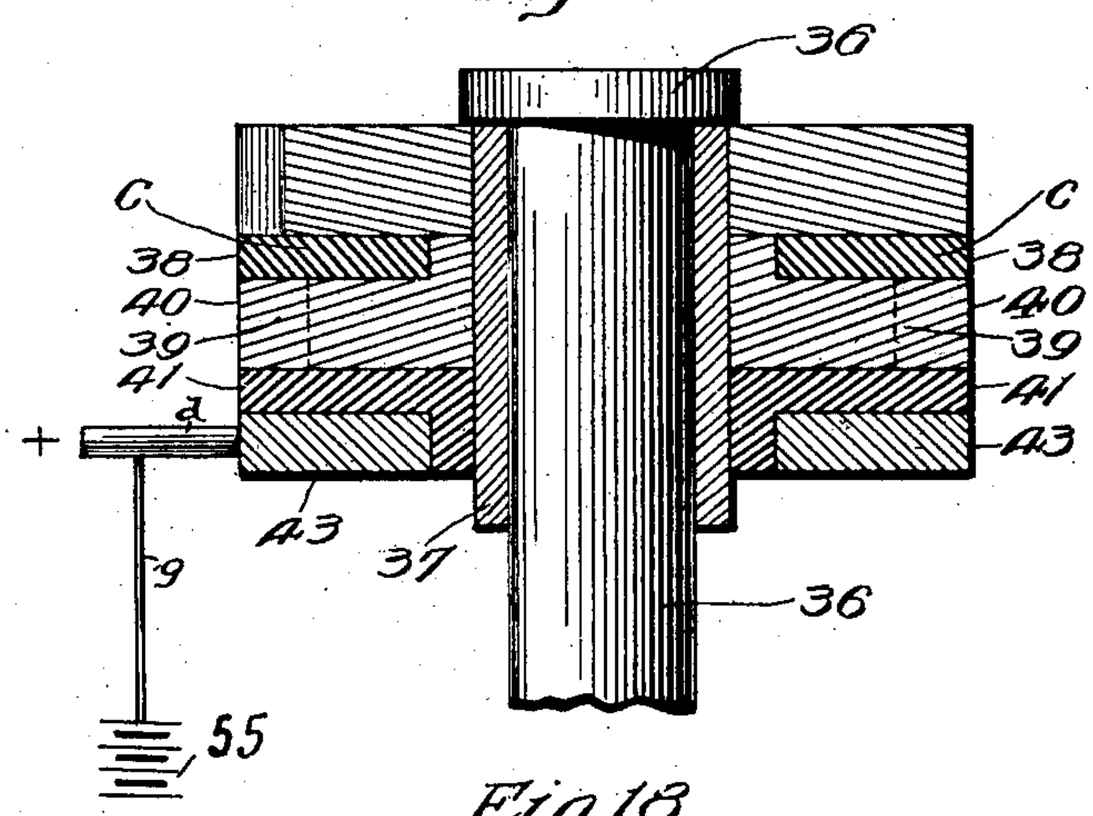
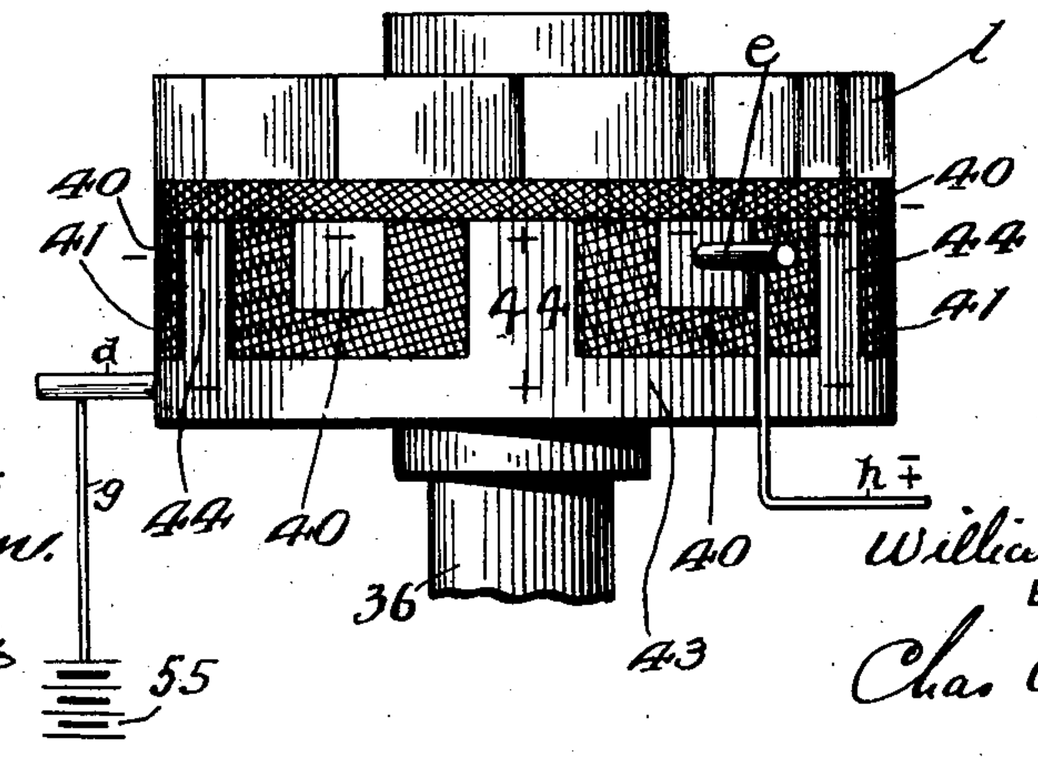


Fig. 18.



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No. 762,331. Patented June 14, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM D. MARKS, OF WESTPORT, NEW YORK.

ELECTRIC SIGNAL.

SPECIFICATION forming part of Letters Patent No. 762,331, dated June 14, 1904.

Application filed March 12, 1903. Serial No. 147,390. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. MARKS, a citizen of the United States, and a resident of Westport, Essex county, New York, have invented certain new and useful Improvements in Electric Signals, of which the following is a specification.

This invention relates to improvements in electric railway-signals, its object being to provide a simple and efficient electric signal apparatus which will not be liable to disarrangement and which will include both audible and visible signals which can be simultaneously and corroboratively actuated. To furnish an acceptable signal system of this character, it is necessary that the parts be so constructed and arranged that the signals normally indicate "danger" and will immediately assume such indicating position when any derangement of the operating mechanism occurs. Thus in the present system the signals are so arranged that if there is any break or derangement of the system the semaphores will at once assume or remain in the position indicating "danger," the lights will be extinguished or lighted to indicate "danger," and the bells will sound or be silent, according to the circuit relations in which said signal devices are arranged.

In the accompanying drawings, Figure 1 is a diagrammatic view of a railway equipped with my treble-guard signal system. Fig. 2 is a plan of one of the commutator-carrying boxes, part of the top of the box being broken away to expose the interior mechanism. Fig. 3 is a section of Fig. 2 on line A A. Fig. 4 is a section of Fig. 3 on line B B. Figs. 5, 6, 7, and 8 are detail perspective views of parts of the commutator. Fig. 9 is a plan of the commutator-box, part of the top of which is broken away, showing the arrangement used when the commutator is operated mechanically by contact with a train or car. Fig. 10 is a side elevation of the lever for mechanically operating the mechanism within the commutator-box. Fig. 11 is a diagrammatic elevation showing the arrangement of the despatcher's board. Fig. 12 is a side elevation of the mechanism for controlling the bells upon the despatcher's board. Fig. 13 is a diagrammatic side elevation of signal lamps, bells, and a semaphore operated by the passage of a train or car. Fig. 14 is a perspective view of a section of railway-track, a signal-operating box, and a third rail in electric connection with the electric contact of the signal-box. Fig. 15 is a perspective view of a part of a railway-track, showing the adaptation of my signal system to a steam-railway. Fig. 16 is a plan view, upon an enlarged scale, of the commutator and the ratchet-wheel carried thereby. Fig. 17 is a section of Fig. 16 on line C C. Fig. 18 is a side elevation of the parts shown in Figs. 16 and 17.

Referring to the drawings, in the several figures of which like reference characters indicate corresponding parts, *a* designates a box or casing, hereinafter termed the "commutator-box." Any suitable number of these boxes are employed and they are arranged at any desired distances apart, the space or distance between succeeding boxes being termed a "block." Each of said boxes *a*, which is usually of such form as to be arranged between the rails of a track and is of such solid construction that it is not liable to injury from the most severe shock in usage, is provided with an air and water tight top or cover *b*. Within each commutator-box is arranged a commutator *c*. The construction of this commutator is shown most clearly in Figs. 2 to 8, inclusive, and 16, 17, and 18. Referring to these figures, it will be seen to consist of a sleeve 37, mounted to turn about a stud or pin 36, secured to the base of the box *a* and having at one end a ratchet *l*. A metal plate or ring 39, provided with a series of projections 40, is secured to said sleeve 37 and through it and the pin 36 connected to the base of the box *a* or permanently "grounded." A washer 41, of insulation material, surrounds a portion of the sleeve 37 and is provided with a series of projections 42, which interlock with the projections 40 on the plate 39, as shown in Figs. 17 and 18. Another plate 43, of conducting material, is also secured to the sleeve 37, it being insulated therefrom by the said insulating-washer 41. This plate 43 is provided with tongues or projections that extend longitudinally of the

sleeve 37 between the projections on the insulating-washer 41, whereby, as shown most clearly in Fig. 18, sections of the tongues are brought into alinement with but insulated from the projections 40 on the plate 39. An insulation-washer 38 separates the acting portions of the plate 39 from the ratchet *l*. A brush *d* is constantly in engagement with the plate 43 of the commutator, and said brush is connected with a feed-wire *g*, leading from any suitable source of current-supply. The commutator is provided with two other brushes *e f*, of copper or carbon, and respectively connected to wires *h i*, leading from the box or casing *a*. As shown, the said brushes *e f* are arranged to contact with the projections 40 on the permanently-grounded plate 39 and the tongues of the plate 43 arranged in alinement with said projections 40. Said brushes are so arranged that when one of them is in contact with a projection 40 of the grounded plate 39 the other brush will be in contact with a section of the plate 43. These relative positions of the brushes and plates 39 43 are reversed at every step-by-step movement of the commutator. The wire *h*, leading from the brush *e*, extends from the commutator-box *a* to the opposite end of the block in rear of said box. The wire *i* extends from the brush *f* to the opposite end of the block in advance of said box *a*, and is provided with a branch *k*, which extends to the opposite end of the block in rear of said box. There are thus three wires extending throughout the length of each block of the system, which wires may be supported on poles or in any suitable manner.

From the foregoing description and the drawings it will be seen that the plate or disk 43 of the commutator is constantly energized, while the plate 39 thereof is constantly or permanently grounded, and therefore according as the brushes *e f* contact with the projections 40 or said plate 43 the wires leading therefrom will be grounded or positively energized. As the commutator is rotated the said brushes *e f* will, as aforesaid, alternately engage the projections 40 and the plate 43, and thus cause a reversal of the direction of current through the wires leading therefrom. It will be seen that in all positions of the commutators and at all times there are two wires or conductors connected to one pole of the source of energy, and hence of the same polarity, extending from each commutator-box, one of said wires extending into or along the block in advance of the box and the other extending into or along the block in rear of said box. A third wire, connected to the other pole of the source of energy, and hence of opposite polarity from the two just referred to, extends from each commutator-box into or along the block in rear of said box. There are therefore three wires extending along or arranged in each block, two of which are of the same polarity, while the third is of the opposite polarity, and at each actuation of each commutator the polarity of the wires leading therefrom is reversed. The means for effecting such rotation of the commutator may be operated either electrically or mechanically. A pawl *m* is pivotally mounted on a lever *o*, fulcrumed on a stud *p*, and said pawl engages the aforesaid ratchet *l* of the commutator. A detent *n* is provided for preventing backward movement of said ratchet. If it is desired to employ electrical means for operating the commutator whenever a car passes the commutator-box *a*, a suitable brush (not shown) mounted on the car engages an insulated contact-piece *r*, Figs. 3 and 4, with which is connected, by means of a wire *s*, a solenoid *t*. One end of the lever *o* is connected, by a rod *v*, with the core *u* of said solenoid. When the solenoid is energized, the pawl *m* will be disengaged from one of the teeth of the ratchet *l* and moved into engagement with the next succeeding tooth. As soon as the car has passed the box *a* and the current is cut off from the solenoid *t* the spring 1, surrounding rod *v* and bearing at its ends against a stop 2 and collar 3 on said rod, returns the lever *o* and parts connected therewith to the position occupied before the solenoid was energized, which movement turns the ratchet *l* and commutator one step. The spring may be assisted in this operation by a spring 4, surrounding a rod 5 and attached at one end to a fixed stop 6 and at the other end to a collar 7, carried by its rod 5, one end of which rod is attached to the opposite end of the lever *o* from that to which the core of the solenoid *t* is connected.

A rod 8, attached to the pawl *m* and passing through a guide 9, is operated on by a spring 10 to maintain the pawl in position to engage the ratchet *l*.

If it is desired to actuate the pawl *m* and its connected parts mechanically, the arm *o* is secured to the stud *p*, which is extended sufficiently through the top of the box *a*, and to the upper end of which is attached a lever 11, Figs. 9 and 10, adapted to be struck by a suitable stop or pin carried by the car. The movement of lever 11 causes a similar movement of lever *o* and its connected parts to that above described.

By employing mechanical means for actuating the commutator-moving mechanism it is possible that a car devoid of electrical energy will operate the system when passing over the box *a*, while the electrical means requires the use of some form of current-supply for its operation.

Any suitable number of signals may be arranged in each block. As before stated, it is preferred to employ semaphores, lights, and bells. These may be arranged in two sets, one set being adapted to control the passage of a car in one direction and the other set to

control the passage of a car in the opposite direction. Such an arrangement is particularly advantageous in connection with single-track roads, where the signals upon one side of the track would control the movements of cars traveling in one direction and those on the other side would control the cars traveling in the opposite direction.

The manner of connecting the several signal devices to the conductors *h* and *i k* in each block is indicated in Figs. 1 and 13. In Fig. 1 two sets of semaphores 12 13 are shown upon opposite sides of the track. Lights 14 are indicated on one side of the track and bells 15 upon the opposite side thereof. For convenience of illustration and description the track is shown as circular in Fig. 1. It will be seen that every block is provided with two semaphores, one adjacent each end thereof, which are simultaneously and similarly actuated. In addition any suitable number of bells 15 and lamps 14 are provided in each block. Both bells and lamps may be arranged at each end of each block, although in order to avoid confusion in the drawings such duplication is not shown. Each semaphore-arm 16 is pivotally mounted upon a suitable support 17, and by means of a link 18 one end thereof is connected with the core 19 of a solenoid 20. The parts are so constructed and arranged that the core 19 acts as a weight to move the semaphore to the position indicating "danger" whenever the solenoid 20 is deenergized. The terminals of said solenoid 20 are connected by conductors 45 46 with two of the main conductors or wires *h i k* in the block controlled by such signal, and the lights 14 and bells 15 in each block are connected with two of such conductors *h i k* therein through branch lines 47 48.

The operation of the system constructed as heretofore described may be briefly stated as follows, referring particularly to Fig. 1 of the drawings. The normal condition of the main conductors *h i k* is indicated in Fig. 1, the conductors which are positively energized being designated by the sign + and those which are grounded being indicated by the — sign. It will be seen that the parts are so arranged that normally the solenoids 20, except those controlling the semaphores at the ends of or within the block or blocks over which cars are passing, will be energized and the semaphores controlled thereby be held in the vertical position, indicating "safety"—that is, both of the main conductors to which the solenoid branches 45 46 are connected in those blocks along which cars are traveling will be either positively energized or grounded, thus preventing any current passing to the solenoids controlling the semaphores referring to the said occupied blocks. The main conductors, to which the solenoids 20 in the "clear" blocks are connected, will be respectively energized and grounded, so that current will pass through said solenoids and the semaphores actuated thereby be maintained in the safety position. One pair of the main conductors with which the branches 47 48 are connected in any occupied block will be positively energized and the other will be grounded, and in blocks which are clear both members of said pair of main conductors will be either energized or grounded. In the illustration a car is passing over the block between stations 1 and 2, in which block the conductor *i*, leading from the box *a* at station 1, is grounded, and the conductors *h k*, leading from the commutator-box at station 2, are respectively positively energized and grounded. As the wires 45 46 of the solenoids for actuating the semaphores referring to said block are connected to the then-grounded wires *i k*, said solenoids will be deënergized and the semaphores will gravitate to the position indicating "danger." The bells or lights 14 15 referring to said block, being connected by wires 47 and 48 with the grounded wire *i* and positively-energized wire *h*, will be lighted or rung as long as the car is traversing said block. As the car passes the commutator-box *a* at station 2 the commutator in said box will be actuated as before described and the wires *i k*, leading from said box, (which were previously grounded,) will be positively energized and the wire *h*, leading from said box at said station 2, (previously positively energized,) will now be grounded. As the wire *i*, leading from the box *a* at station 1, remains grounded, it will be seen that the solenoids 20 of the semaphores controlling the block between stations 1 and 2 will be energized, as the wires 45 46 are connected to the conductors *h i*, and the said semaphores will be thereby moved into the safety position, indicating that the track in said block is clear. The conductors *k h*, extending from the box *a* at station 3 along the block between stations 2 and 3, being respectively positively energized and grounded and the wire *i* in said block being positively energized, it will be seen that the bell and lamp circuits in said block between stations 2 and 3 will be closed and the semaphore-solenoids in said block deënergized, whereby all of said signal devices will be caused to indicate that the block is occupied or to assume the danger position or condition. In the illustration a track-switch is shown in the block between stations 2 and 3, and it will be assumed that the car entering said block is to enter said switch to permit a car to pass in the opposite direction over the main track in said block. The second car approaching from the direction of station 4, its attendants will find the signals at the entrance to block between stations 3 and 2 in the condition indicating that said block is occupied, (such signals having been caused to assume these danger positions or conditions by the passage of the car then on the switch over

the box *a* at station 2.) The car occupying the switch is, however, in sight of attendants on the car at station 3, and therefore the latter car can safely proceed onto the block between stations 3 and 2. As the last said car passes from block 3 2 to block between stations 2 and 1 it will set the signals in both said blocks at "danger," but those in block between stations 2 and 3 will be returned to the safety position as the car previously on the switch passes from said block into the block between stations 3 and 4. As an additional precaution it is proposed to connect each commutator or signal-box *a* with the train-despatcher's office, (conventionally illustrated at 46[a] in Fig. 1.)

Referring particularly to Figs. 2, 9, 11, and 12, 49 is a separate feed-wire which may lead from the same source of current as the wire *g* or from any other suitable supply. Said wire 49 is conducted to a contact 22 within box *a*. A contact 23, carried by but insulated from the lever *o*, is adapted to contact with said contact 22. A wire 21 connects the contact 23 with a binding-post 59 at the despatcher's office. Said binding-post is connected with one branch, 31, of a circuit including a bell 26, the other branch, 32, of said bell-circuit being connected to a switch-lever 28. This lever is fulcrumed on a suitable support and provided at one end with a bridge or plate 24, adapted to electrically connect the binding-post 59 with one of the terminal wires 50 of a solenoid 25. The other terminal of said solenoid is connected by a wire 51 with a permanently-grounded wire 30. The said bridge 24, though connected with the lever 28 and movable thereby, is, as shown in Fig. 12, insulated from said lever. The lever is connected to the core 27 of the solenoid 25 and is provided with a projection or finger adapted to bear against a contact 29, connected to the aforesaid permanently-grounded wire 30, when the connection between the binding-post 59 and solenoid 25 is broken.

It will be understood that the parts hereinbefore described in connection with the despatcher's office signal apparatus are duplicated for each one of the boxes *a*. Normally current will pass through the wire 49, contacts 22 23, wire 21, binding-post 59, and bridge 24 to the solenoid 25 and therefrom through the wires 51 and 30. The solenoid being energized maintains the switch-lever in the position shown in Fig. 12 and the bell-circuit open. When the lever *o* is rocked by a car passing the box *a*, in which said lever is arranged, the circuit above described is broken at the contacts 22 23 within the box, and the switch-lever 28 will instantly fall and bear against the contact 29. This maintains the solenoid-circuit open, and as soon as the lever *o* is restored to its original position (which occurs the instant the car passes the box *a*) a bell-circuit is closed and the bell rings. This circuit includes the wire 49, contacts 22 23, wire 21, binding-post 59, bell-wires 31 and 32, lever 28, contact 29, and wire 30. This circuit will remain closed until the switch-lever 28 in the despatcher's office is raised and the circuit, including the solenoid 25, completed. By this means the despatcher's office is audibly informed whenever a car passes any one of the signal-boxes *a*.

As before stated, any suitable source of electric energy may be employed in connection with the signal system herein described, and the strength of the current will of course depend on the number of signals to be operated, the length of the system, &c.

If the commutators *c* are to be operated electrically, the contact *r* can be continued from the box to any desired distance in the blocks on opposite sides of the box by means of a suitable conductor, such as a third rail 33. (Shown in Fig. 14.) When the contact on a car contacts with this conductor, the commutator-actuating solenoid *t* in circuit therewith will be energized and the commutator actuated as before described.

In case the system is used in connection with an electric railway and the current supplied to the commutators be kept constantly at, say, five hundred volts and the cars be each fitted with a wiper or contact-piece connected with the ironwork and wheels the signal system will be operated by contact of the wiper with the plate *r* whether the trolley is in contact with its supply-wire or not, as the contact of the wiper and plate will, through the ironwork and wheels of the car, short-circuit the current with the rails and cause the actuation of the solenoid *t*, which is constantly at five hundred volts.

In Fig. 15 is shown an adaptation of the signal system to a steam-railway. Referring to this figure, 34 is a track or pilot battery operating relay controlling power-current. 35 is a feed-wire connected with the signal-box *a*. (Conventionally illustrated in said figure.) The entire construction and operation of the system is similar to that hereinbefore described.

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

1. An electric railway-signal system comprising in combination, a series of boxes or stations dividing the track into blocks, two wires of different polarity or potentiality leading from each station, one into the block ahead of the station, the second into the block behind the station, and a branch of the first into the block behind the station, means for energizing said wires, means, actuated by the passage of a car, for reversing the polarity or potentiality of the current carried by said wires, signals operated by electromagnets, the terminals of which are, when the car is in the block, connected to wires of the same polarity

or potentiality and when the car has passed out of the block and the polarity or potentiality of two of said wires has been reversed, to wires of different polarity or potentiality, and electrically-operated signals, the opposite terminals of which are connected, when a car is in the block, to wires of opposite polarity and when the car is out of the block to wires of the same polarity.

2. An electric railway-signal system comprising, in combination, a series of boxes or stations dividing the track into blocks, a commutator in each of said boxes furnished with two series of contact-points, one series being grounded and the other connected with a source of electrical energy, two wires adapted to be in engagement with, at one time, the one with the grounded part and the other with the energized part of said commutator and upon a movement of said commutator the first with the energized and the second with the grounded parts of said commutator, one of said wires leading into the block in front of said commutator, and a branch thereof into the block behind said commutator, and the other of which reaches into the block behind said commutator, electrically-operated signals in each of said blocks, the terminals of which are connected, when a car is in the block, to wires of the same polarity and when the car is out of the block, and the polarity of one of said wires reversed, to wires of opposite polarity, and electrically-operated signals the opposite terminals of which are connected, when the car is in a block to wires of opposite polarity and when the car is out of the block, and the polarity of one of said wires reversed to wires of the same polarity.

3. An electric railway-signal system, comprising, in combination, a series of boxes or stations dividing the track into blocks, a commutator, in each of said boxes, divided into an equal number of contact-points one half of which are in electrical connection with a source of electric energy and which are of positive polarity and the other half of which are insulated from the first half, of an opposite polarity or grounded, two wires carried from each station, one forward and backward, the other backward only, said wires being at one time, one connected with the positive contact-points and the other with the negative contact-points of said commutator, said contacts being reversed upon a movement of said commutator, means, actuated by the passages of a car, for rotating said commutator, and two sets of electrically-operated signals, one set having its terminals connected one to a wire leading backward from a station next in front of a car, the other to a wire leading forward from a station next behind a car, the other set having its terminals connected one to the other wire leading backward from the station next in front of the car, and the other to the wire leading forward from the station next behind the car, so that one set of signals will be alternately, one in an operative electrical circuit, the other in an inoperative electrical circuit.

4. In combination, inclosing boxes, a commutator consisting of an equal number of positive and negative contact-points, the former insulated from the latter, in each of said boxes, a connection at each box between said former points and a source of electrical energy, a connection at each box between the latter points and the ground, a ratchet-wheel fast to said commutator and having twice as many teeth as there are either positive or negative contact-points on said commutator, brushes in each box adapted one to engage a positive while the other engages a negative contact-point and vice versa, means actuated by a passing car for drawing said ratchet-wheels around with a step-by-step motion, upon each passage of a car, a wire leading from one of said brushes, both to the front and rear of a box, a wire leading from said box to its rear, a wire leading from the rear box toward said first box, and signals electrically connected to said wires, so as to be operative or inoperative as the currents upon the several wires are of the same or of different polarity.

5. The described three-wire electric signal system comprising, in combination, a series of boxes or stations, two wires of different polarity or potentiality leading from each station, one into the block ahead of the station, the second into the block behind the station, and a branch of the first into the block behind the station, so that between each station are three parallel wires, two of the same and one of opposite polarity, means for conducting current to said wires, means at each station, actuated by the passage of a car for reversing the polarity or potentiality of the current carried by said wires leading from said station, and electrically-operated signals the opposite terminals of which are so connected to said wires as to be in an operative or in an inoperative circuit, as may be dictated by the polarity or potentiality of said several parallel wires.

6. In an electric signal system, in combination, a lever adapted to be rocked upon the passage of a car, means actuated by the movements of said lever for electrically operating signals along the line of track, a contact-point carried by said lever, a contact-point insulated from said lever, said contacts adapted to make and break a circuit upon the movements of said lever, a connection between said latter contact-point and a source of electrical energy, a connection between said former contact-point and a binding-post in a central office, a solenoid, a connection between said solenoid and said post, an electrically-operated signal, a connection leading from said post to said signal, a bridge in electrical connection with

said post, a lever, to which the core of the solenoid is connected, carried upon an insulated pivot and adapted when raised to engage said post, a connection leading from said signal to said lever, a grounded connection adapted to be engaged by said lever when said lever is dropped, and a connection leading from said solenoid to the ground, the whole arranged and operating substantially as and for the purposes set forth.

7. In a three-parallel-wire electric signal system, in combination, a block having a box or station at each end, two wires always of opposite polarity leading from one box or station toward the other, a wire, which is alternately positive and negative, leading from the second box or station toward the first box or station, means for supplying current to said wires, means, operated by a passing car, for reversing the polarity of the said two first wires, and an electrically-operated double system of signals so connected with said wires as to either simultaneously indicate safety or danger, depending upon the polarity of the currents upon the three parallel wires to which they are connected; or to indicate that the system is out of order, if it be disarranged or broken, by a simultaneous contradictory operation of the double system of electrically-operated signals.

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