No. 751,780. PATENTED FEB. 9, 1904.

H. E. BRADLEY.

ELECTRIC SIGNAL.

APPLICATION FILED OCT. 3, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

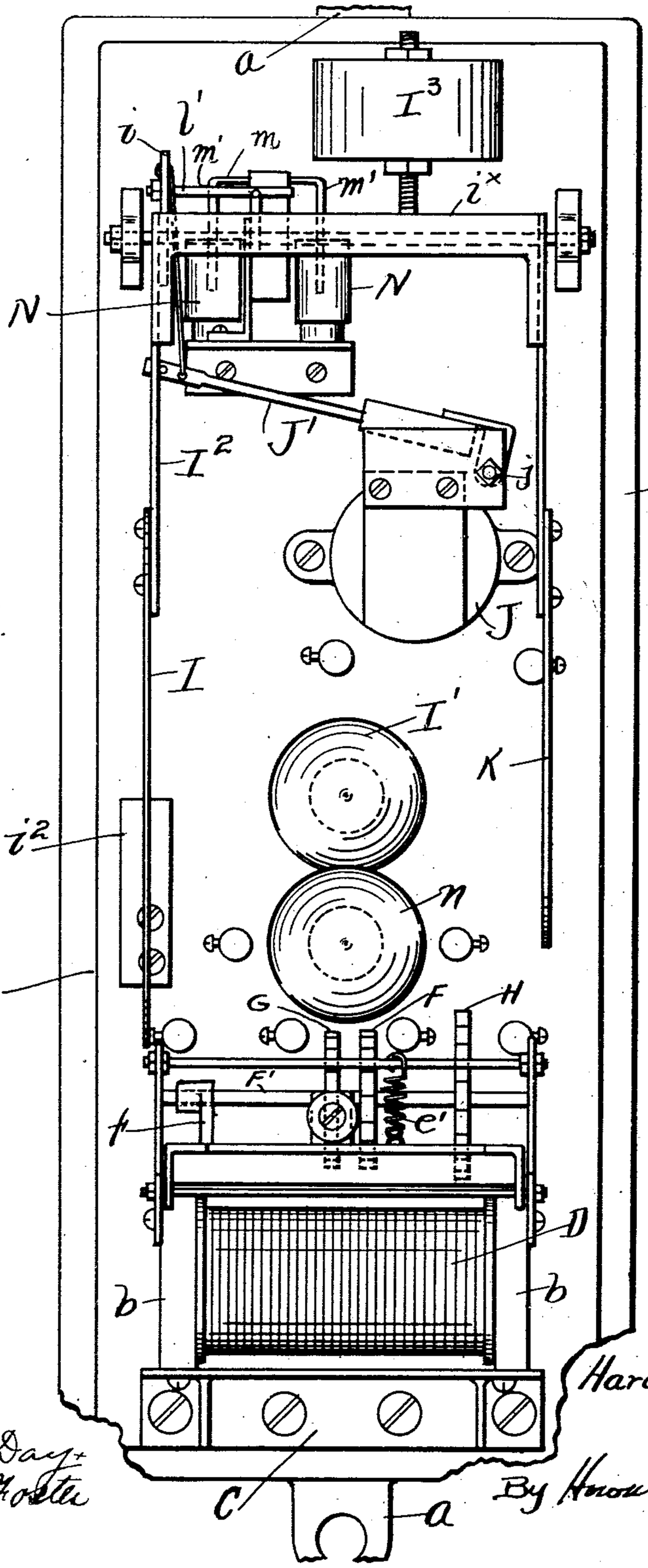

Fig. 1.

Witnesses

Chas. P. Day

Frank A. Foster

Inventor

Harold E Bradley

By Howard E. Barlow

Attorney

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 4 SHEETS—SHEET 2.

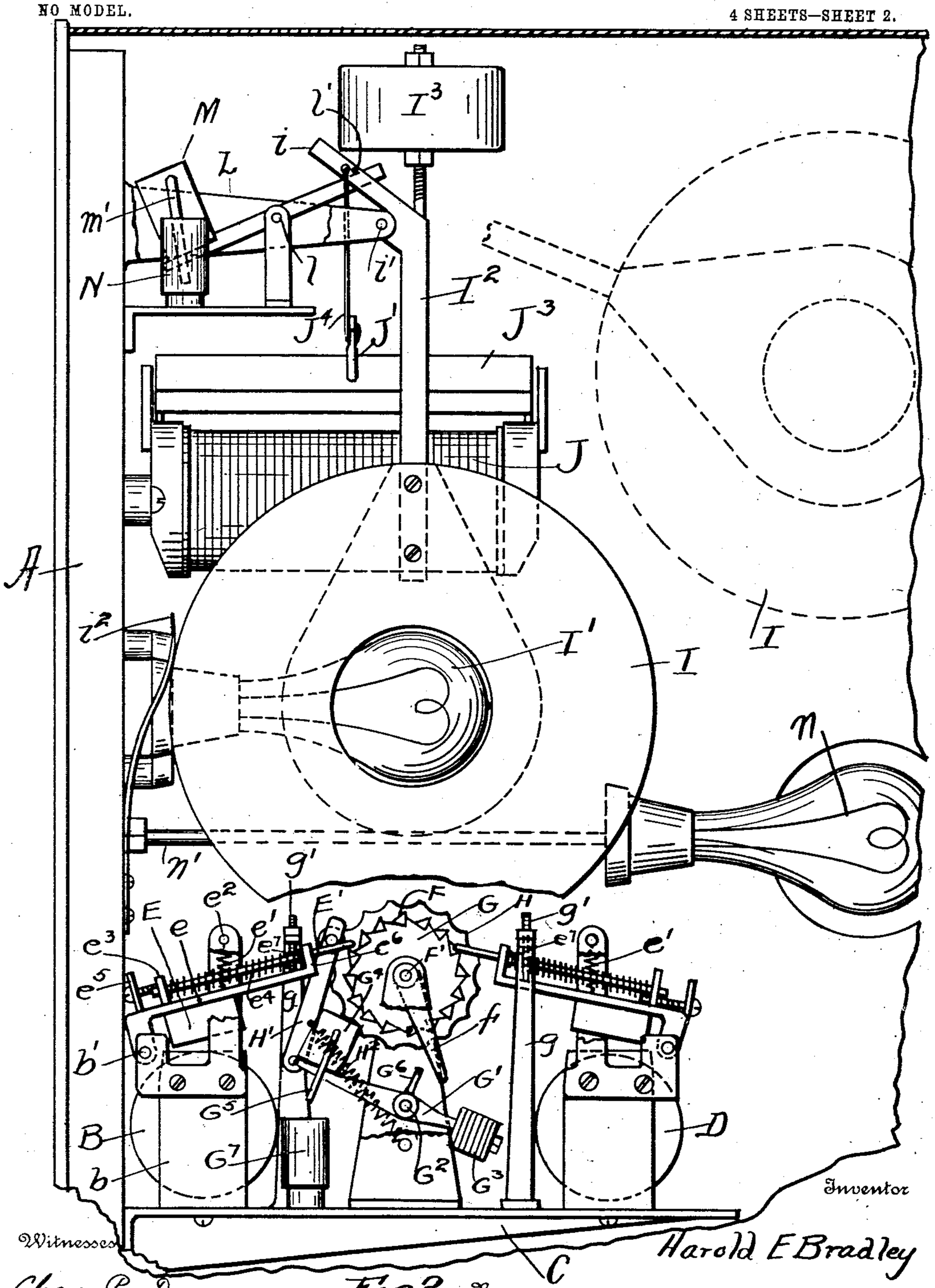

Fig. 2.

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NO MODEL. 4 SHEETS—SHEET 3.

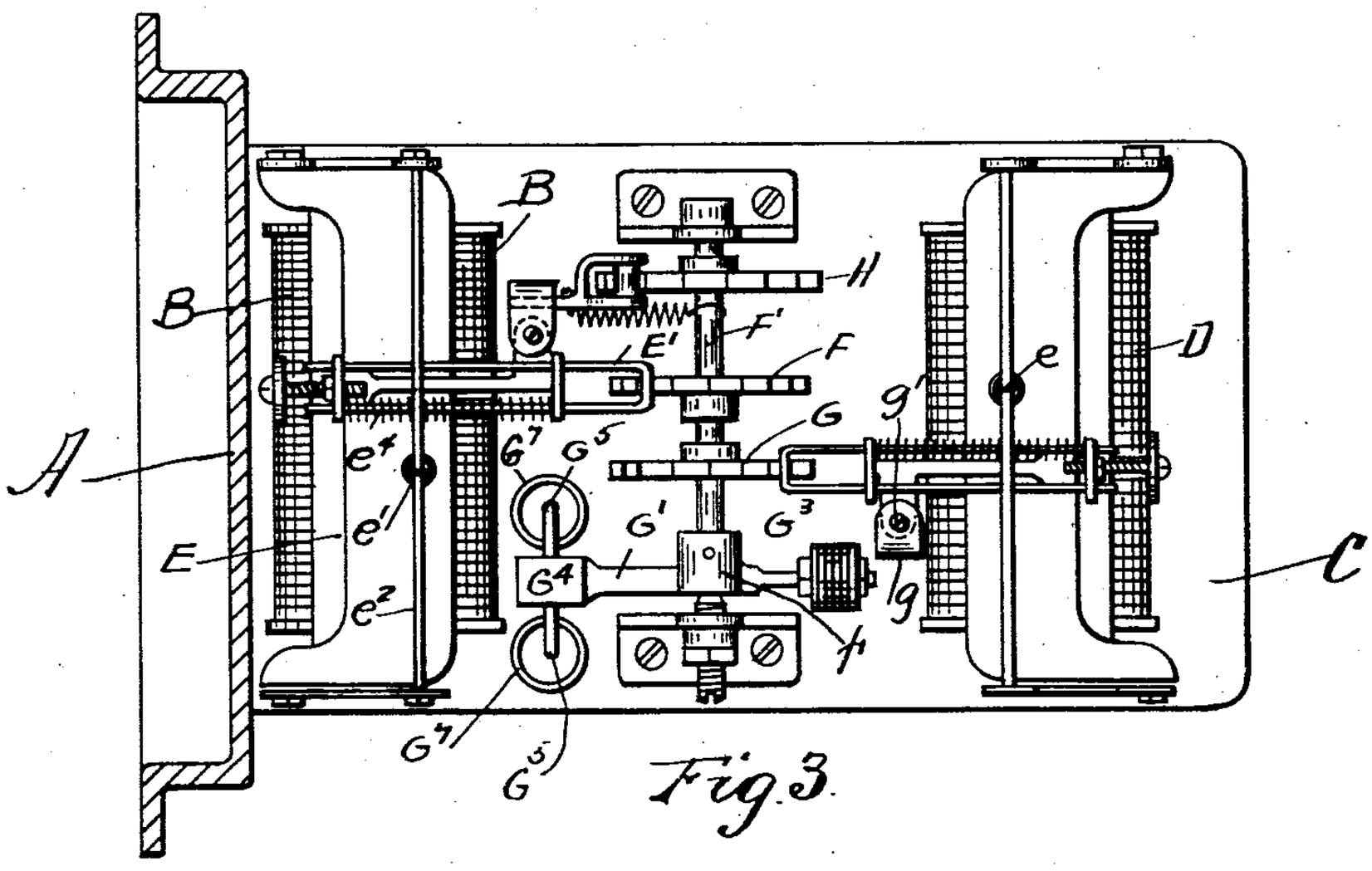

Fig. 3.

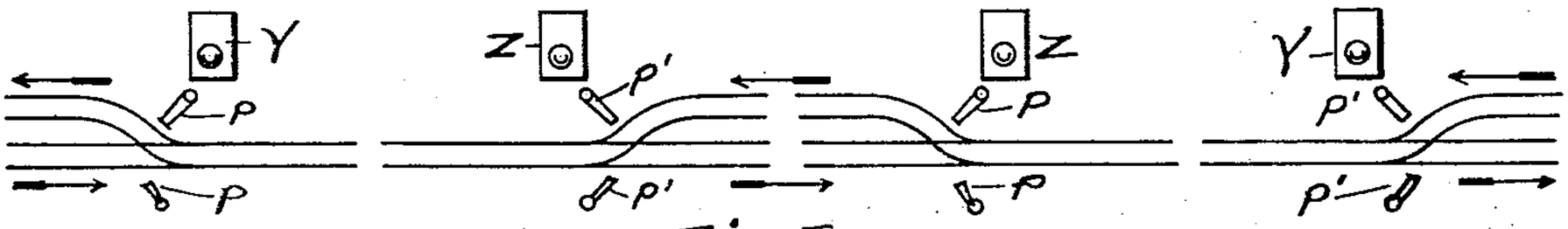

Fig. 5.

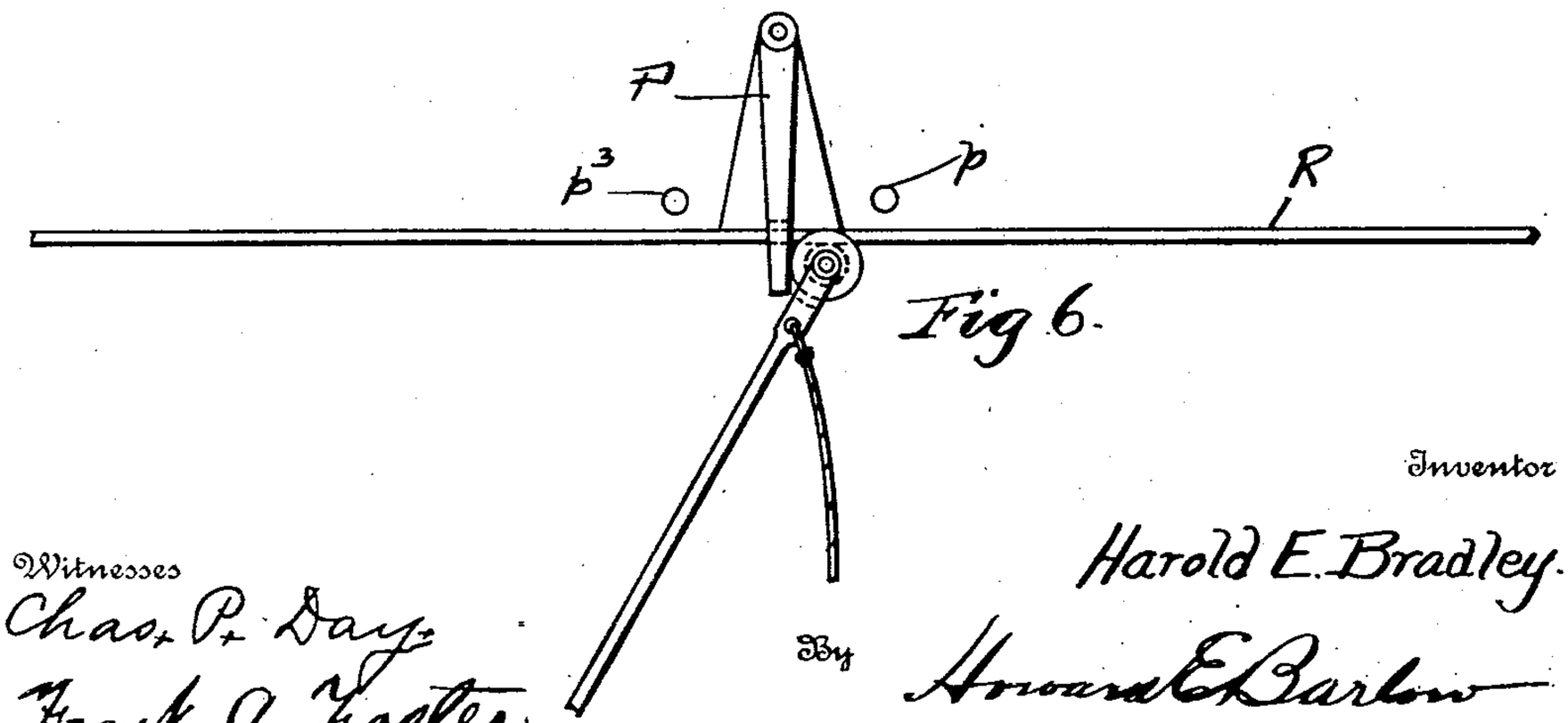

Fig. 6.

Witnesses
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NO MODEL. 4 SHEETS—SHEET 4.

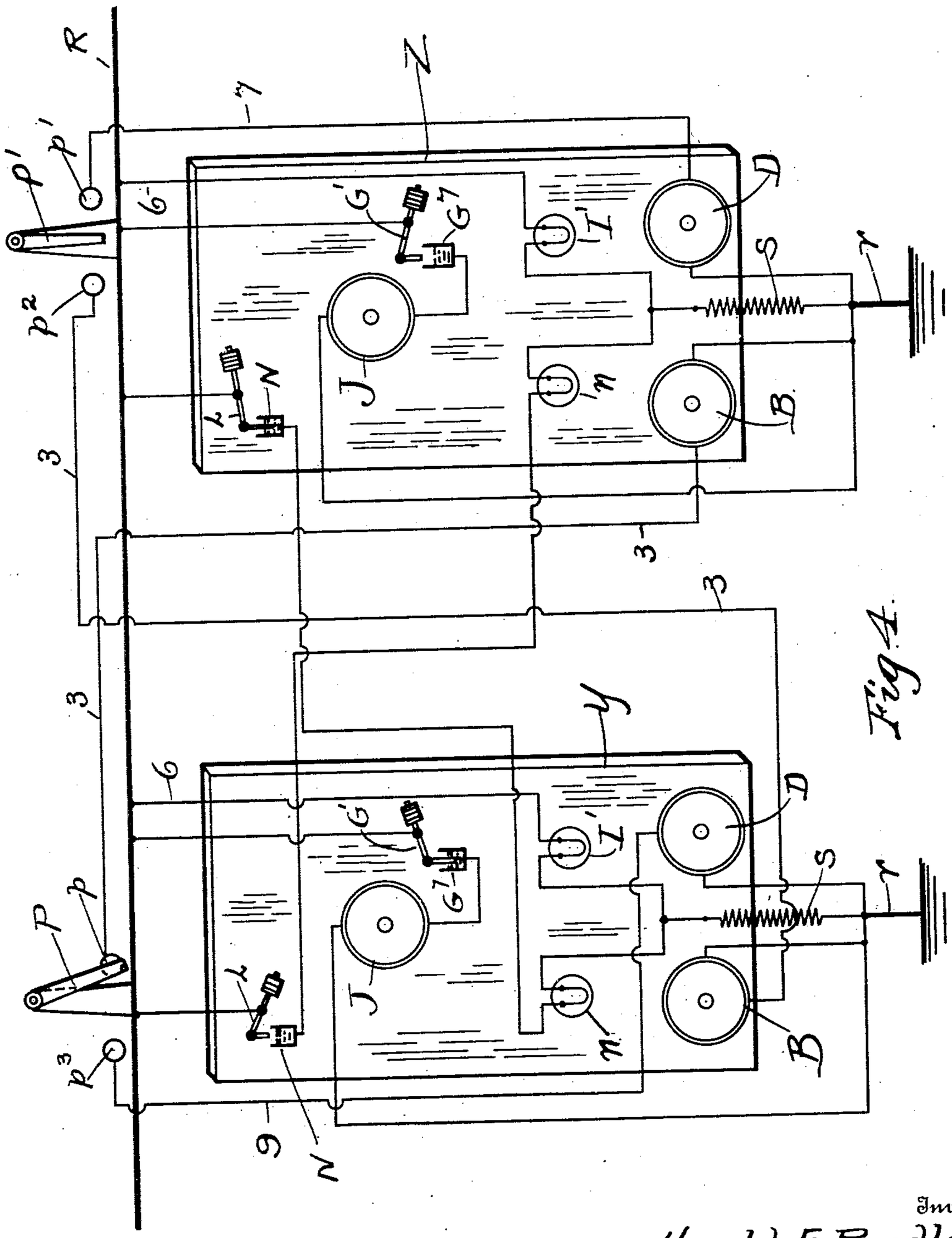

Fig. 4.

Witnesses
Chas. P. Day.
Frank A. Foster

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Harold E Bradley.

By Howard C Barlow.
Attorney.

No. 751,780. Patented February 9, 1904.

UNITED STATES PATENT OFFICE.

HAROLD E. BRADLEY, OF WARWICK, RHODE ISLAND.

ELECTRIC SIGNAL.

SPECIFICATION forming part of Letters Patent No. 751,780, dated February 9, 1904.

Application filed October 3, 1903. Serial No. 175,572. (No model.)

To all whom it may concern:

Be it known that I, HAROLD E. BRADLEY, a resident of Greenwood, in the town of Warwick, in the county of Kent and State of Rhode Island, have invented certain new and useful Improvements in Electric Signals; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

My invention relates to railway block-signaling systems, the object of the invention being to provide a simple, practical, and effective electrical railway block-signaling system in which the signals will be actuated automatically by the passing cars to indicate the presence or absence of other cars on the track sections or blocks, said signals being so arranged that they will indicate to a car entering the block whether or not the track is clear ahead.

In the use of my device on railways where it is desirable to allow one or more cars to enter the block from the same direction before the first car to enter has left the block I have provided means whereby the signal which is set when the first car enters shall return to its normal position only when the last of said series of cars shall have left the block.

The invention consists of novel features and parts and combinations of the same, as will be fully described hereinafter and then pointed out in claims.

A practical embodiment of the invention is presented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a plan view of my signaling mechanism with the casing removed. Fig. 2 is a side elevation of the mechanism with one side of the casing removed. Fig. 3 is a plan view of the mechanism which is actuated by the incoming and outgoing cars as they enter and leave the block. Fig. 4 is a diagrammatic view illustrating my system of wiring between the signals at each end of the block. Fig. 5 illustrates a section or block of single car-track with turnouts and my signaling devices at each end of said turnouts controlling said blocks. Fig. 6 illustrates one method by which the passing car may operate a switch by contact with the trolley to actuate the signal at each end of the turnout.

Referring to the drawings, A is the base, to which is secured the signal-operating mechanism. On each end of this base are ears *a a*, by which said base may be secured in position on a pole or other convenient place to display the signals.

B is an electromagnet which is actuated by the incoming cars. It is supported on the bracket C, which bracket is bolted to the base. This magnet, contrary to the customary construction, has its armature E placed lengthwise of the core and is acted upon by the pole-pieces *b b* on both ends thereof. This armature is fixed to the lever *e*, which lever is pivoted in the rear of the magnet at *b'*, allowing the armature to be raised out of contact with said pole-pieces when they are deënergized by the tension of spring *e'*, which is connected to it and to a supporting frame or bar e^2, located above it for that purpose. On this lever *e* are two ears e^3 and e^6. In these ears is supported a spring-pawl E', which pawl is constructed of wire made in a U shape, (see Fig. 3,) both legs of which have bearings in said ears. Around one leg of this pawl is wound a small spiral spring e^4, one end of which spring rests against the collar e^7, fixed to said pawl. This spring is for the purpose of pressing each pawl out after it has been pressed in by the ratchet-wheel as it is raised to take another tooth. The screw e^5 with the large head or collar is for the purpose of preventing said pawl from being thrown in too far when the ratchet is revolved quickly, thereby preventing said ratchet-wheel from turning more than one tooth at a time.

F is the ratchet-wheel actuated by the downward movement of this pawl E', said ratchet-wheel being mounted on and fixed to a revoluble shaft F', on which shaft is also mounted and fixed ratchet-wheel G, detent-wheel H, and switch-bar-operating finger *f*.

At D is the magnet which is actuated by the outgoing cars. This magnet is also supported on the bracket C and in its construc-

tion and operation is an exact duplication of magnet B, as is also the mechanism which engages and operates the ratchet-wheel G, and therefore requires no further detail description. The detent-pawl H′ is held against the said detent-wheel H by the tension of spring H^2, preventing the same from turning in either direction when the ratchets are not being acted upon by either of the magnets.

In the upper end of the standards *g g* are adjustable stop-screws *g′ g′*, which screws limit the upward motion of said pawls when drawn upward by the springs *e′* after being released by the magnets.

G′ is a switch-bar pivoted near its center at G^2 to a suitable supporting-frame. This bar is weighted at one end at G^3, while its opposite end supports an insulating-block G^4. In this block is held a contact-wire, said wire having two depending legs G^5 G^5. (See Fig. 3.) When the switch-bar G′ is thrown down by contact of finger *f* with the leg G^6, each of these depending wires enters a mercury-cup G^7 G^7 and completes a circuit to raise the target I by mechanism which will hereinafter be described.

At J is a third electromagnet, similar in construction to the two magnets B and D above described. The armature J^3 to this magnet is also pivoted in the rear at *j*, as illustrated in Fig. 1. Extending outward from the front edge of said armature J^3 is the arm J′, which arm is connected by a suitable flexible connection J^4 to the downwardly-extending end of the target-arm *i*.

At I is the danger-target or oscillating signal-disk, in the center of which is a transparent red glass or other suitable transparent material, with the broad outer ring or border colored red, the transparent center being to show the color by night, while the rim or border of the disk displays the danger-signal by day.

At I′ is the incandescent lamp which shines through the colored transparent center. This target is suspended on the end of an arm I^2, which arm is pivoted at *i′* and is counterbalanced by the weight I^3, as shown in Fig. 1. A second disk or target K is connected through the bar $i^\times$ to the target I. This target K is somewhat smaller than target I and more in the shape of a banjo-target. It is, however, colored green and has a transparent center portion which reflects a green light at night. As this target is placed on the opposite side of the electric lamp I′, it shows the green or safety light to cars approaching from one direction, while cars approaching from the opposite direction see the red or danger signal.

At L is a switch-bar pivoted near its center at *l*. On one end of this bar is an insulating-block M, in which block is held a contact-wire *m*, said wire having two depending legs *m′ m′*. (See Fig. 1.) The opposite end of the switch-bar extends outward and engages a pin *l′*, which latter is carried by an extension *i* of arm I^2. When the magnet J is de-energized, the targets fall by their own gravity from the dotted position to the position indicated by the full lines shown in the drawings in Fig. 2, thus allowing the depending legs of the contact-wire *m′* to be carried down into the mercury-cups N N and complete the circuit necessary to light the cautionary-signal lamp *n*, which is supported on the end of rod *n′*, the wiring for which will be hereinafter described. The flat spring i^2 forms a stop against which the target I falls when it drops to its danger position.

I do not wish to be restricted to the exact construction herein shown and described, as many slight modifications may be necessary to accommodate my device to the various conditions under which the same may be operated without departing from the spirit and scope of my invention.

The operation of the apparatus and circuit connections of the system illustrated in Figs. 4 and 5 may be more fully described as follows: My signaling system is particularly adapted for use on a single-track road with turnouts such as that illustrated in Fig. 5 of the drawings, each section of single track constituting what is known as a "block." Each end of each section is provided with a signaling apparatus Y and Z, (see Fig. 5,) both of which apparatus are actuated at the same time to set the necessary signals when a car enters an empty block and to restore said signals to normal conditions when the last car leaves the block. When a car enters from the left, the trolley-wheel comes in contact with and operates a switch-lever P, a simple form of said gravity-returned lever being shown for illustration in Fig. 6. This lever may be thrown to the contact button or point *p* by the passing trolley or by any other convenient method and through the wire 3 acts on signal Z (see Fig. 4) to energize the magnet B and cause the mercury switch-bar G′ to rise and break the electric connection, deënergizing the magnet J, and allow the target I to fall to the danger position. (See Fig. 2.) As this target falls it also allows the switch-bar L to fall and connect the mercury-wells N, causing the current to pass through line 4 and light the cautionary signal, which signal is the incandescent lamp *n*, that shows a green light either day or night at the entering end of the block, thus notifying the entering car that the danger-signal at the opposite end of the block has been set. This cautionary signal can only be set when the danger-signal at the opposite end of the block is in its proper position. When more than one car enters the block from the same direction, the magnet B is energized and through the mechanism described above turns back the finger *f* a step each time a car enters the block after the signals have been set, and this finger is returned again a step to-

ward its normal position each time a car leaves the block, until but a single car remains on the block. When the last car passes out of the block and switch-lever P′ is thrown onto contact-point p', the magnet D is energized through conducting-wire 7 and through the mechanism above described causes the switch-bar G′ to descend and make a connection through the mercury-cups G^7, thus energizing magnet J, raising the target out of the danger position, clearing the signals, and at the same time raising or disconnecting the mercury-switch N, breaking the circuit and extinguishing the light of the cautionary signal n. The train in entering the block from the right or opposite direction operates on the signals the same as those approaching from the left. The lever P′, being thrown over against contact-point p^2, acts on signal Y at the opposite end of the block, energizing magnet B, and through the above-described mechanism throws out of contact the mercury-switch G^7, deënergizing magnet J, allowing the target to fall to the danger position. The target in falling to this position allows the mercury switch-cup N to make a contact and light the cautionary signal n. The train in leaving this block throws lever P onto contact-point p^3, which through wire 9 energizes magnet D and through the magnet-operated mechanism makes the contact through the switch G′, energizing magnet J to raise the target and clear the danger-signal, at the same time disconnects the switch L, extinguishing the cautionary signal n at the opposite end of the block.

The current by which the signal mechanism is operated is taken from the trolley-wire R, as is shown by the system of wiring illustrated in Fig. 4. After the current has passed through its circuit and performed its work it is conducted through the wire r to the ground, and where it passes through the lamps it is arranged to pass out through the resistance-coil S to the ground.

In the operation of the system as so far described it will be seen that the signal at the distant end of the block is set first and that the signal at the entering end is set only after the signal at the distant end is in position. The signal at the entering end thus affords an indication that the system is in order and that the signal at the distant end has been set to prevent the entrance of a car onto the block from the opposite direction.

It will be noted that in the construction of my signal I have provided that if for any cause the wiring should break or the apparatus get out of order the danger-signal will be set automatically. Should this danger-indicating target for any reason fail to fall to the danger position, then the cautionary signal at the entering end of the block will not be set. When said cautionary signal is not set, it indicates to an approaching car that the signaling device is out of order or that there is danger ahead.

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

1. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, a counterbalanced circuit-breaker in circuit with said magnet, an oscillating operating-arm for said circuit-breaker normally engaged therewith, and electromagnetic means for controlling said operating-arm.

2. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in normally inoperative position, a counterbalanced circuit-breaker in circuit with said magnet, an oscillating operating-arm for said circuit-breaker, a second electromagnet, an armature pivotally mounted thereon, and means carried by said armature for moving said operating-arm out of engagement with said circuit-breaker.

3. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, a counterbalanced circuit-breaker in circuit with said magnet, an oscillating shaft, a ratchet-wheel mounted thereon, an operating-arm for said circuit-breaker mounted on said shaft, a second electromagnet, an armature pivotally mounted upon the latter, and means carried by said armature for rotating said ratchet-wheel, whereby said operating-arm is disengaged from said circuit-breaker.

4. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, a counterbalanced circuit-breaker in circuit with said magnet, an oscillating operating-arm for said circuit-breaker, electromagnetic means for moving said arm out of engagement with said circuit-breaker, and additional electromagnetic means for returning said arm to its normal position.

5. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, separated contacts in circuit with said magnet, a pivotally-mounted lever weighted at one end and provided at the other with a circuit-closing device for said contacts, and means for normally holding said lever against the action of said weights.

6. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, separated contacts in circuit with said magnet, a pivotally-mounted lever weighted at one end and provided at its other end with a circuit-closing device for said contacts, an oscillating arm, and means for con-

trolling said arm, whereby said lever may be held against the action of said weights.

7. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, separated contacts in circuit with said magnet, a pivotally-mounted lever weighted at one end and provided at the other with a circuit-closing device for said contacts, an oscillating arm adapted to hold said lever normally against the action of said weights, and an electromagnet adapted to disengage said arm from said lever.

8. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, separated contacts in circuit with said magnet, a pivotally-mounted lever counterbalanced at one end and provided at its other with a circuit-closing device for said contacts, an oscillating arm adapted to engage said lever, electromagnets, armatures pivotally mounted thereon, and means carried by said armatures for oscillating said arm.

9. In a device of the character described, the combination of a target, an electromagnet adapted to hold the same in a normally inoperative position, separated contacts in circuit with said magnet, a pivotally-mounted lever counterbalanced at one end and provided at its other with a circuit-closing device for said contacts, an oscillating arm, a lug or finger projecting from said lever in the path of said arm, and electromagnetic means for oscillating said arm.

10. In an electric signaling device, the combination of an electric switch, a finger mounted on a shaft to control said switch, two ratchet-wheels mounted on said shaft and facing in opposite directions, a spring-actuated sliding pawl to engage each ratchet-wheel, a magnet for operating each of said pawls, said magnets having but one coil, a core extending through said coil, pole-pieces at each end of said core, and an armature pivoted near its end to swing on an axis parallel to that of said core and controlled by both of said poles.

11. In a signal, a target to indicate danger or safety according to its position, a magnet to control the target, a switch to control the activity of the magnet, a finger to control the switch, said finger being mounted on a shaft carrying a detent-wheel and two ratchet-wheels, two magnets, one on each side of the shaft and having their cores parallel with the shaft, and means to enable the magnets to move the ratchet-wheels step by step in opposite directions.

12. In a signal, a target to indicate danger or safety according to its position, a magnet to control the target, a switch to control the activity of the magnet, a finger to control the switch, said finger being mounted on a shaft carrying a detent-wheel and two ratchet-wheels, two magnets, one on each side of the shaft and having their cores parallel with the shaft, each of said magnets having but one coil, a core extending through said coil and pole-pieces at each end thereof, an armature pivoted near its ends to swing about an axis parallel to the core and controlled by both of said poles, and means to enable the magnets to move the ratchet-wheels step by step in opposite directions.

13. In an electric signaling device, an electric switch, a shaft, oppositely-arranged ratchets mounted on said shaft, a depending finger carried by said shaft and adapted to engage said switch, and magnetically-actuated pawls adapted to move said ratchets, whereby said finger is oscillated.

14. In an electric signal, an electric switch, a shaft, a ratchet-wheel mounted thereon, a detent-wheel also mounted on said shaft, a pawl therefor, a finger carried by said shaft and adapted to engage said switch, an electromagnet, an armature pivoted thereon, and means carried by said armature for operating said ratchet-wheel step by step.

15. In a signal, an electric switch, a shaft, oppositely-arranged ratchet-wheels mounted on said shaft, a depending finger carried by said shaft and adapted to engage said switch, oppositely-arranged magnets, armatures pivotally mounted thereon, and means carried by said armatures for imparting step-by-step movements to said ratchet-wheels, whereby said finger is oscillated.

16. In a device of the character described, the combination of a swinging target, a mercury-cup switch actuated by the movement of said target to automatically set a cautionary signal at another station when said target moves to the danger position, and an electromagnet having but one coil, a core extending through said coil, and pole-pieces at each end thereof, an armature pivoted near its ends to swing about an axis parallel with the core and controlled by both of said poles, said magnet being for the purpose of raising said target from the danger position when energized, means whereby said target will fall automatically to the danger position when said electromagnet is deënergized.

17. In a signal, a finger, a detent-wheel, and a ratchet-wheel, all mounted on one shaft, an electromagnet having its core parallel with the shaft, and means to enable said magnet to turn said ratchet-wheel step by step.

18. In a signal, a finger, a detent-wheel, two ratchet-wheels facing in opposite directions, all mounted on one shaft, two electromagnets mounted on opposite sides of the shaft and having their cores parallel with the shaft, and means to enable the magnet to move the ratchet-wheels alternately step by step in opposite directions.

19. A railway block-signaling system having a magnet in combination with an armature controlled by said magnet, a longitudinally-

slidable spring-actuated pawl mounted on said armature, said pawl being for the purpose of controlling the signal-operating switch through the medium of a ratchet-wheel.

20. In a signal, means for transmitting impulses from a magnet to a ratchet-wheel including a guide-frame supported by the magnet, a sliding pawl working in said frame, and means to enable the magnet to move the frame.

21. In a signal, means for transmitting impulses from a magnet to a ratchet-wheel, including a guide-frame supported by the magnet, a pawl sliding in the frame, a spring to press the pawl outward toward the ratchet-wheel, and means to enable the magnet to move the frame.

22. In a signal, means for transmitting impulses from a magnet to a ratchet-wheel including a frame, a pawl sliding in the frame, a spring to move the pawl outward toward the ratchet-wheel, means for limiting the movement of the pawl, and means to enable the magnet to move the frame.

23. In a signal, means for transmitting impulses from a magnet to a ratchet-wheel including a frame, a pawl sliding in the frame, a spring to move the pawl outward toward the ratchet-wheel, means for limiting the inward and outward movement of the pawl, and means to enable the magnet to move the frame.

24. In a signal, means for transmitting impulses from a magnet to a ratchet-wheel including a frame, a pawl sliding in the frame, a spring to move the pawl outward toward the ratchet-wheel, a stop-screw adapted to limit the inward movement of the pawl, and means to enable the magnet to move the frame.

25. In a signal, means for transmitting impulses from a magnet to a ratchet-wheel, a frame, a sliding pawl working in the frame, and means to enable the magnet to move the frame including a magnet having but one coil, a core extending through said coil, and pole-pieces at each end thereof, an armature pivoted near its ends to swing about an axis parallel to said core and controlled by both of said poles.

26. In a signal, means for transmitting impulses from a magnet to a ratchet-wheel including a frame, a pawl sliding in the frame, a spring to press the pawl outward toward the ratchet-wheel, and means to enable the magnet to move the frame, including a magnet having but one coil, a core extending through said coil, and pole-pieces at each end thereof, an armature pivoted near its ends to swing about an axis parallel with said core and controlled by both of said poles.

27. An electric signaling device comprising an electric switch, a ratchet-wheel for operating the same, an electromagnet, an armature pivotally mounted thereon, a frame carried by said armature, and a spring-pressed pawl mounted in said frame.

28. An electric signaling device, comprising an electric switch, a ratchet-wheel for operating the same, an electromagnet, an armature pivotally mounted thereon, a frame carried by said armature, a spring-pressed pawl mounted in said frame, and a stop-screw mounted in said frame to limit the inward movement of the pawl.

29. A railway block-signaling system comprising a magnet, an armature pivotally hung from and controlled in its action by said magnet and carrying a pawl, a ratchet-wheel, mercury-cups, a switch arranged to engage said mercury-cups to form a connection, a switch-controlling finger, means whereby when more than one car enters the block from the same direction said magnet is energized by each car entering the block to carry back said finger a step at a time, the first car entering allowing the switch to break the electric circuit, deënergize said second magnet and allow the target to fall to the danger position, means for returning said finger to throw the switch and raise the target when the last car leaves the block.

30. A railway block-signaling system having a single-coil magnet, an armature pivotally hung from and controlled in its action by said magnet and carrying a spring-actuated sliding pawl, a ratchet-wheel, a switch, a switch-controlling finger, means whereby when more than one car enters the block from the same direction said magnet is energized by each car entering the block to carry back the finger a step at a time, the first car entering allowing the switch to break the circuit to deënergize a second magnet and allow the target to fall to danger position, a third magnet energized by an outgoing car, said magnet actuating a ratchet through a pawl to return said finger so the last car leaving the block will cause said switch to make the electric connection necessary to energize magnet No. 2 and raise the signal out of the danger position.

31. The combination of a signal-box at each end of a block, an electric switching device arranged at each end of the block, secondary magnets, connecting-wires extending from said switching devices to said secondary magnets, whereby the latter are actuated by the electric impulses derived from said switches, armatures for the secondary magnets, a frame attached to each armature, a pawl sliding in the frame, a swinging target or signal, a magnet to raise the target from danger to safety when said magnet is active, and to allow the target to fall to danger when the magnet is inactive, a switch to control the activity of the magnet, and means to enable the sliding pawl of one of the magnets to open the switch when the first car enters the block and the other pawl to close the switch when the last car leaves the block.

32. In an electric signal, a car-actuated

mechanism having a base-plate, a double-break switching device consisting of two mercury-cups supported by said base and insulated therefrom, a switch bar or plate carried by a switch-lever, said bar being insulated from the lever, and means to move the lever to remove the switch-bar from the mercury-cups when the first car enters the block and to return the switch-bar to the cups when the last car leaves the block.

33. In an electric signal, a car-actuated mechanism having a base-plate, magnets mounted thereon and having their cores parallel with the surface of said plate, extensions from the magnet-poles, armatures hung therein, frames extending outward from the armatures toward the ratchet-wheels, and U-shaped pawls sliding in the frame to turn the ratchet-wheels step by step when the armatures are oscillated.

34. In an electric signal, means for transmitting impulses to a ratchet-wheel including the combination of an electromagnet, an armature therefor, a frame mounted on said armature, and oscillating therewith, a U-shaped pawl sliding in the frame, a washer fastened to one leg of the pawl, and a spring mounted on the pawl between one abutment of the frame and the said washer and acting to press the pawl outward toward the ratchet-wheel.

35. In an electric signal, means for transmitting impulses to a ratchet-wheel including the combination of an electromagnet, an armature therefor, a frame mounted on said armature and oscillating therewith, a U-shaped pawl sliding in the frame, a washer fastened to one leg of the pawl, and a spring mounted on the pawl between one abutment of the frame and the said washer, and acting to press the pawl outward toward the ratchet-wheel, and a stop-screw to limit the backward movement of said pawl.

36. In an electric signal, a base-plate, an upright secured to the same and forming one support of the ratchet-wheel system, two mercury-cups attached to the base-plate, a switch-lever pivoted to the aforesaid support and carrying at one end a bifurcated switch-blade or contact-bar, said bar being adapted to enter the mercury in the cups and complete an electrical circuit from one to the other, a counterbalance at the opposite end sufficient to cause the switch-lever to tilt and break the electric current at the mercury-cup, and means to allow the counterbalance to act when a car enters the block.

In testimony whereof I have hereunto set my hand this 1st day of October, A. D. 1903.

HAROLD E. BRADLEY.

In presence of—

HOWARD E. BARLOW,

FRANK A. FOSTER.