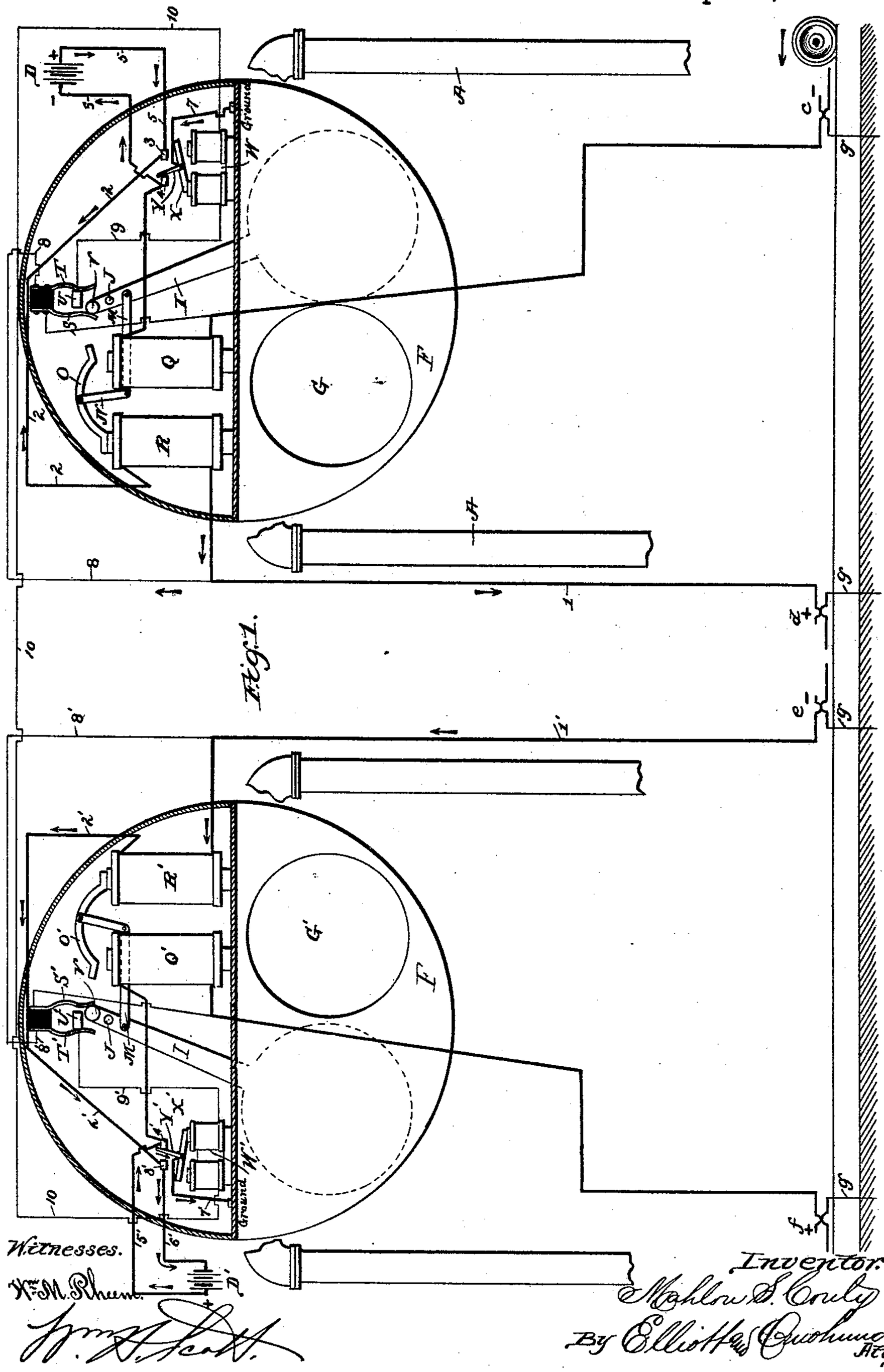
(No Model.)

4 Sheets—Sheet 1.

M. S. CONLY.

BLOCK SIGNAL SYSTEM.

No. 435,482. Patented Sept. 2, 1890.



Witnesses.

Wm. M. Rhem.

W. D. Scott.

Inventor.

Mahlon S. Conly

By Elliott Bros Cushman & Co.

Atty's.

(No Model.)

4 Sheets—Sheet 2.

M. S. CONLY.

BLOCK SIGNAL SYSTEM.

No. 435,482. Patented Sept. 2, 1890.

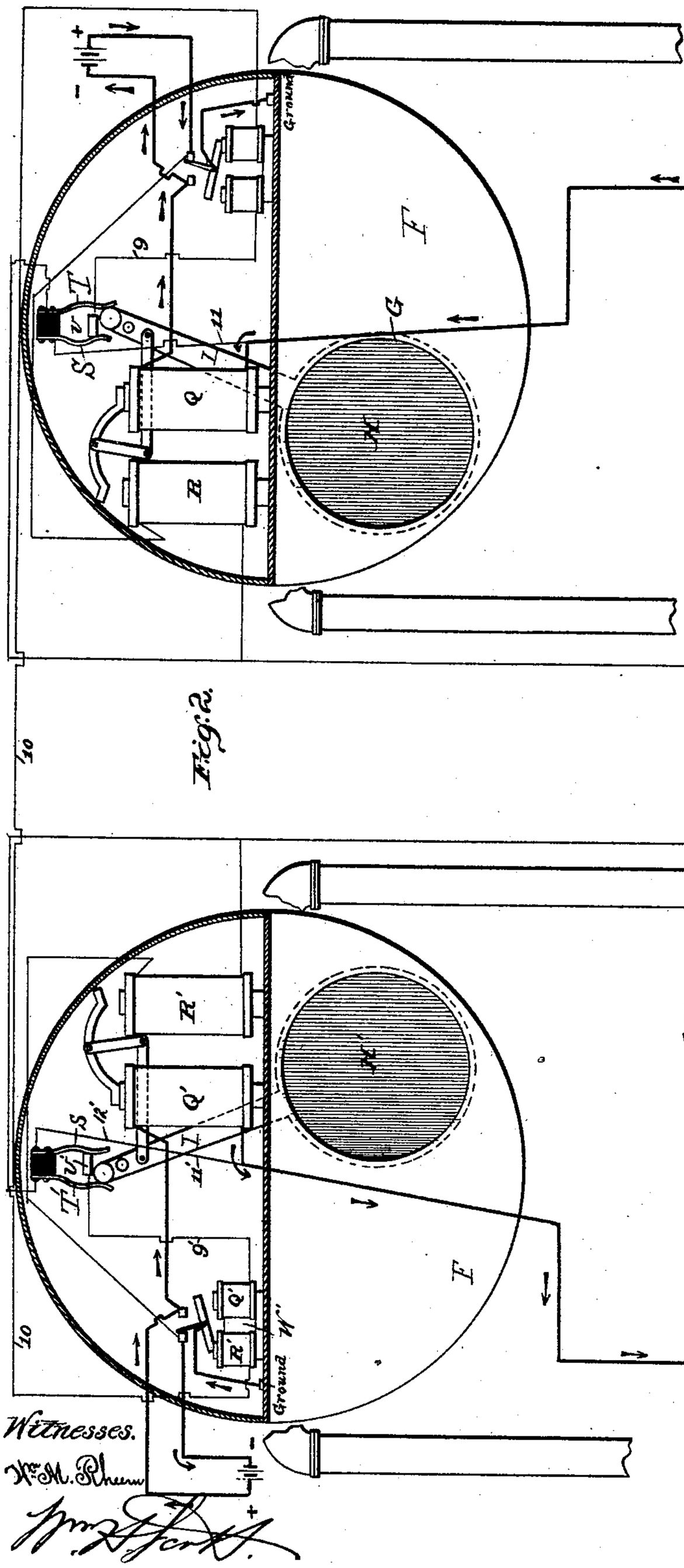


Fig. 2.

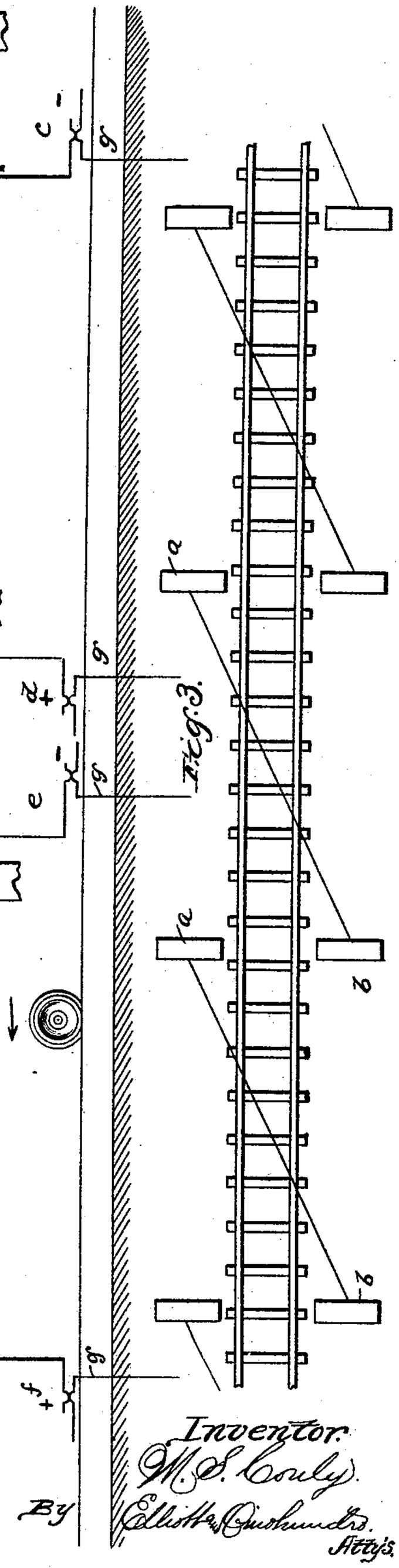


Fig. 3.

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M. S. CONLY.

BLOCK SIGNAL SYSTEM.

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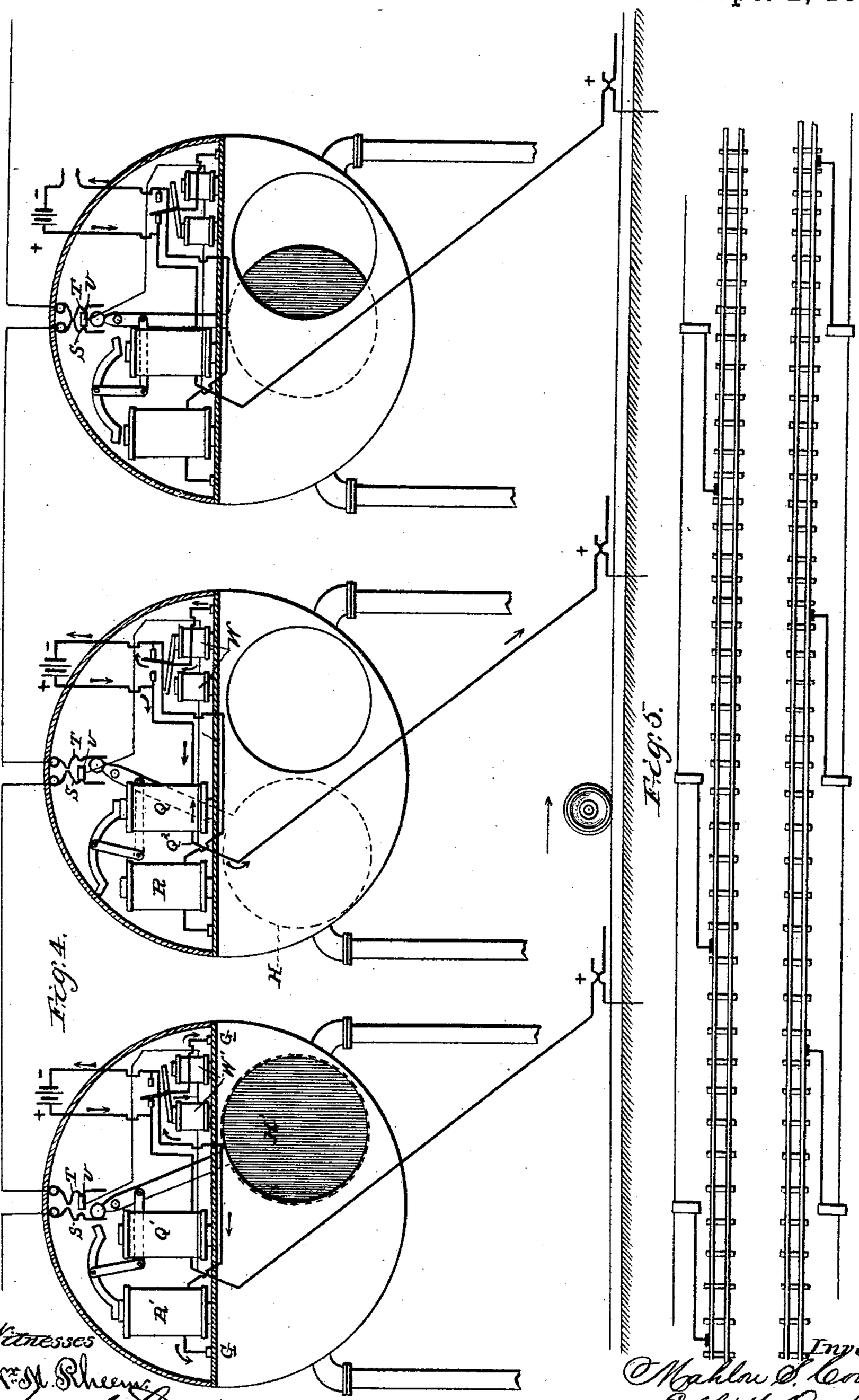

Witnesses
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(No Model.) 4 Sheets—Sheet 4.

M. S. CONLY.

BLOCK SIGNAL SYSTEM.

No. 435,482. Patented Sept. 2, 1890.

Fig. 6.

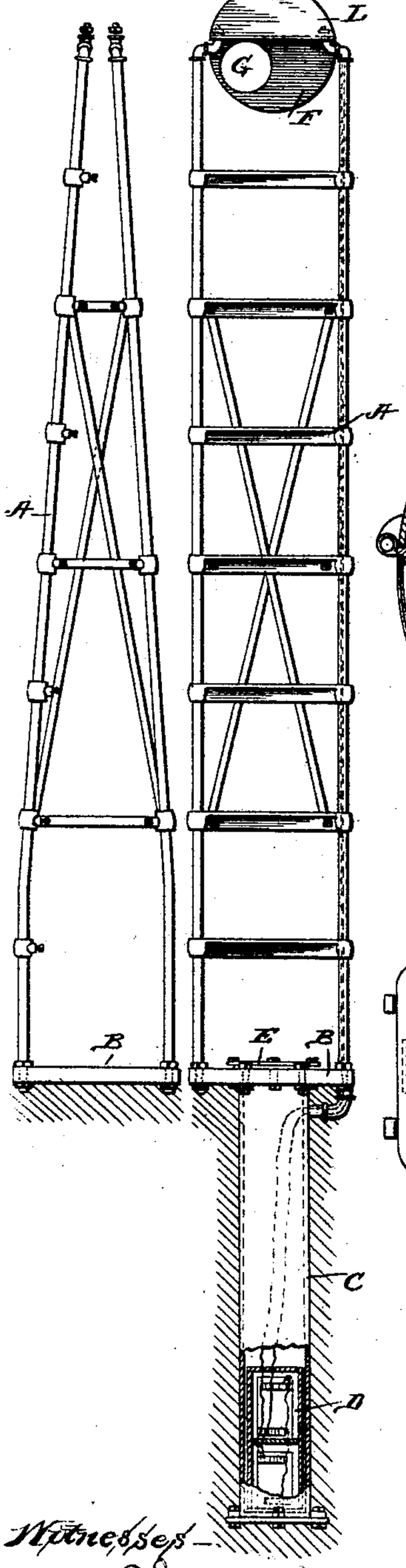


Fig. 7.

Fig. 8.

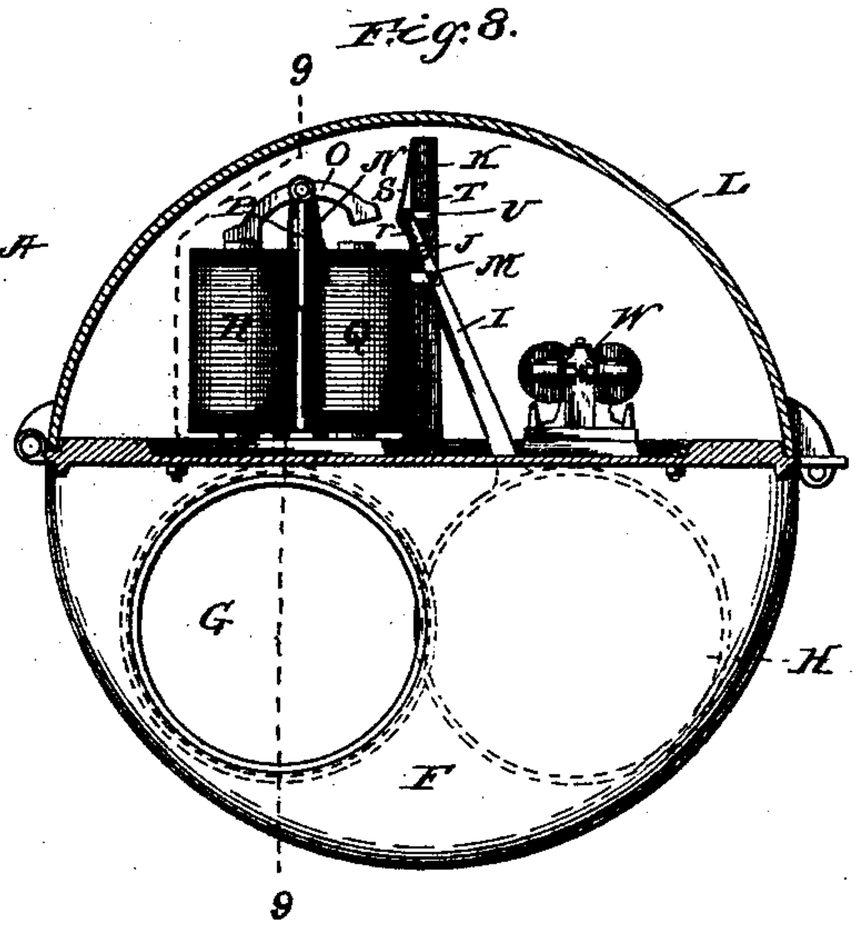


Fig. 9.

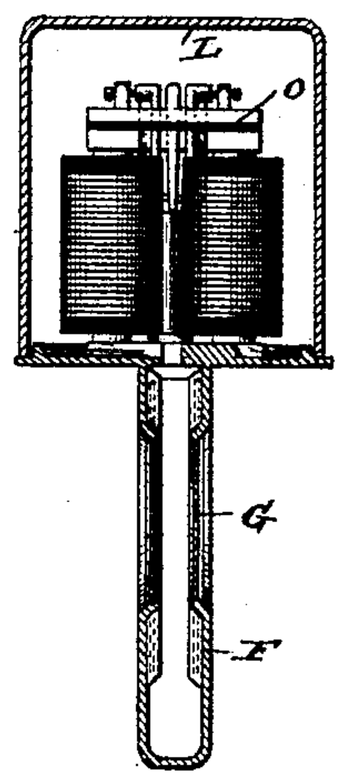


Fig. 10.

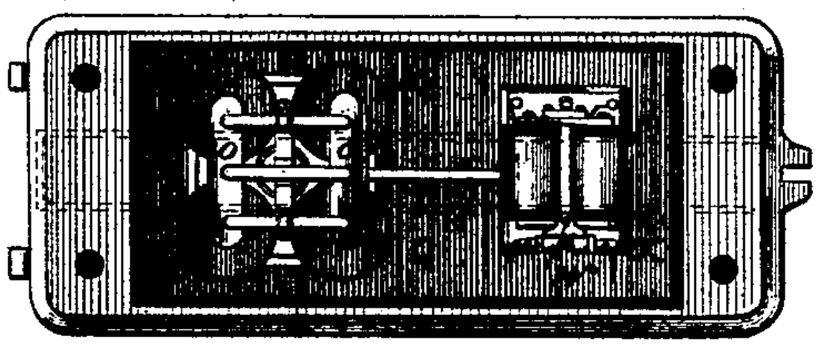


Fig. 11.

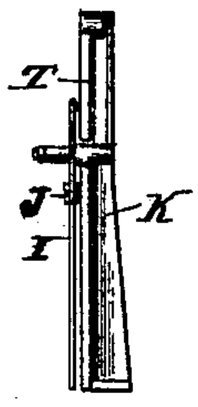
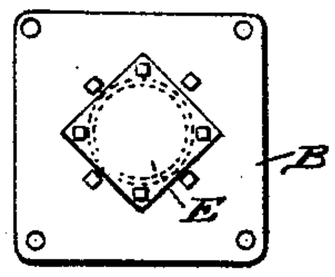


Fig. 12.



Witnesses—
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Wm. H. Scott

Inventor
Marlon S. Conly
Elliott & Quohundro
By
Atty

UNITED STATES PATENT OFFICE.

MAHLON S. CONLY, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE UNITED STATES ELECTRIC RAILWAY SIGNAL COMPANY, OF NEW YORK, N. Y.

BLOCK-SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 435,482, dated September 2, 1890.

Application filed December 7, 1889. Serial No. 332,990. (No model.)

To all whom it may concern:

Be it known that I, MAHLON S. CONLY, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Block-Signal Systems, of which the following is a specification.

This invention relates to improvements in block-signal system especially designed for the use in connection with railways in which elevated or tower signals are arranged along the track at regular intervals, each pair constituting what is known as a "block," and are automatically and simultaneously actuated so as to become visible upon the train entering the block, and likewise simultaneously operated to become invisible upon the same train leaving the block.

The prime object of this invention is to utilize the static discharge of one local circuit caused by the breaking thereof for operating instruments for controlling the current through said circuit, and also through another corresponding local circuit at the opposite end of the block, whereby upon the breaking of either local circuit the signaling devices contained in both of them will be operated so as to become alternately visible and invisible.

Another object is to have a closed local circuit for each target or signal, but connected with the adjacent target or signal in such manner that both of them will be operated simultaneously by the action of a passing train upon the track-instruments accompanying each of the signals and forming a part of each local circuit, whereby one of the signals may become inoperative without deranging the entire system or interfering with the continued and perfect operation of all the other signals in the systems.

A further object is to have the signals or targets actuated to become visible and invisible by opposing electro-magnet included in the local circuit of each signal and to combine with the same devices for alternately magnetizing and demagnetizing said magnets, whereby they will become alternatively active and idle, so as to operate upon the target in rotation, and when active will firmly hold the target in position by force of magnetic attraction.

A still further object is to provide a tell-tale or "out-of-order" indication distinct from "safety" or "danger," so that each signal will indicate when that particular signal-tower is not in working-order and not to be depended upon.

These objects are attained by the devices illustrated in the accompanying drawings, in which—

Figure 1 represents in diagram a block-signaling system embodying my invention as applied to a single-track railway, the two signals shown representing a pair of signals located at the end of a single block and with the targets up or invisible; Fig. 2, a similar view of the same signals, showing the targets down or visible and the position of the various parts of the signal changed accordingly; Fig. 3, a plan view of the single track, showing the disposition of the towers along the same; Fig. 4, a diagram view illustrating the application of my invention to a double-track system, showing three targets along one of the tracks; Fig. 5, a plan view of a double-track railway, illustrating the disposition of the towers along the same; Fig. 6, an end elevation of one of the towers for supporting the signal; Fig. 7, a side elevation thereof, also showing the location of the battery for the local circuit; Fig. 8, an enlarged elevation of the signal-casing, showing a portion of the casing broken away to more clearly disclose the arrangement of the internal mechanism; Fig. 9, a vertical section thereof on the line 9 9 of Fig. 8; Fig. 10, a plan view showing the cap or the covering of the casing removed; Fig. 11, a detail elevation of the supporting-post for the target and its connections; Fig. 12, a detail plan view of the base-plate of the tower.

Similar letters of reference indicate the same parts in the several figures of the drawings.

It is a well-recognized principle of electricity that whenever a closed battery-circuit is broken a static discharge or secondary current is produced simultaneously therewith of high electro-motive force, but small volume, whose tendency is to jump across the break

or opening, and which traverses the line or circuit in the same direction as the primary current, and it is upon that principle that this invention depends for its operation.

My invention is equally applicable to either a single or double track system, and when used in connection with the former enables the throwing of a signal at the ends of each block to the front and the rear of the same simultaneously, withdrawing or rendering invisible the signals previously thrown in the block last passed through. When used in connection with the latter, it enables the throwing of a signal at the end of each block behind the train, which is all that is necessary, because all the trains on the same track move in the same direction, and simultaneously the withdrawing or rendering invisible of the signal thrown at the rear end of the block last passed through.

The mechanism or devices in each case is the same; but as the circuits necessarily differ I will describe the two separately, beginning with the single-track system. This in general consists of a series of visible signals of any suitable character—one on each side of the track, as illustrated in Fig. 3, separated by about a mile—one of each pair lying on the opposite side, but at the same point along the track with one of the signals of the next adjacent pair, so that the train in passing from one block to another will withdraw the signal from the block last passed through, and simultaneously, or nearly so, throw the pair of signals protecting the block just being entered upon, which, by reason of their arrangement at opposite sides of the track, shows a "danger" signal at the right of the track for other trains coming in either direction. Each signal-tower of each pair of signals has its own local battery-circuit, primarily controlled by two track-instruments for each post, which latter normally holds the circuits closed by grounding, one the plus side and the other the minus side of the battery. The track-instruments are so operated by the moving train as to momentarily open or break the circuit at that point. The result of this temporary or momentary breaking of the circuit by the track-instruments causes a discharge of the static electricity absorbed by the entire circuit either in the plus or minus direction, according to which side of the local circuit is open. The static discharge, operating upon a polarized relay connected in the line and through branches connected with automatic switches for the local circuits of the pair of signals, and also with the relay of the other signal of the pair, serves to short-circuit one or the other of two pairs of electro-magnets arranged in opposition to each other in each of the local circuits by grounding that portion of the local circuits in which the last operating electro-magnets are connected, thus giving practically all the energy of the battery to the other pair of electro-magnets, which causes the target of the signal to swing to the opposite position. It will of course be understood that these pairs of magnets are arranged to operate alternately, so that whenever a train passes into the block protected by the pair of signals from either direction both signals will be thrown or become visible, and that whenever the train leaves the block in either direction both signals will be simultaneously withdrawn from view.

Referring now more particularly to the apparatus which is common to both the signals of the single and double track systems, let A represent a tower of any suitable construction resting upon a base B at the ground, to which latter is secured a casing C, extending a suitable distance into the ground and constituting a receptacle for the local battery D, which may thus be placed below the frost-line and beyond danger of freezing, the base being provided with a removable cover E for convenience of inserting and removing the battery.

Upon the top of the tower is supported a casing, preferably circular in form and having two compartments, the lower one F of which is narrower when viewed in cross-section and is provided at one side of the center with an opening G, extending through both walls thereof, in which the target can be seen. This target H works between the walls of the lower portion of the casing, may be of any suitable character that will produce a visual signal—such, for instance, as a colored glass, in contradistinction to a white glass—covering the opening G, and is suspended from an arm I, pivoted at J to a suitable post K, located in the upper chamber of the casing, which latter is provided with a hinged lid or covering L, for affording ready access to the devices located therein. The arm I is also connected, by means of a link M, with an arm N, preferably pendent and extending radially from a rocking double armature O, pivotally supported upon a suitable post P, secured to the casing. Below this armature are located two pairs Q R of electro-magnets designed to alternately attract the rocking armature, which is preferably composed of two branches, upon which the magnets respectively operate. Thus it will be understood that when one pair of magnets is energized so as to attract one side of the armature and rock it in one direction the target will be swung over so as to span and become visible in the opening G of the casing, and upon the other pair of magnets becoming energized and the first pair demagnetized the armature will be rocked and the target swung in the opposite direction, away from the opening G, and concealed behind the solid walls of the casing so as to become invisible.

To the post K is secured a pair of contact plates or springs S T, between the ends of which is located a contact point or block U, the said springs being arranged at one side of and in the path of movement of, so as to be alternately operated by, the free end V of

the arm I of the target, so that whenever the target is operated in either direction one of the spring-plates will be moved out of contact with the block U, for the purpose hereinafter described. In the upper chamber of the casing is also located a polarized relay W, the armature X of which, as more clearly illustrated in the diagram views, is provided with a tongue Y for making and breaking contact between two insulated points, for a purpose which will also be described farther on.

In practice it is preferred to have the framework of such a character that the wires leading from the battery to the signal may be concealed from view and protected from the elements, to which end the frame may be of piping, through which the wires may be strung, and which will also form a ground-connection for the various circuits.

As before stated, each target is equipped with all the devices previously described, and the connection and arrangement of parts are alike in all the signals; but the circuits are arranged somewhat differently in the single and double track systems.

Referring now more particularly to the single-track system illustrated in Figs. 1, 2, and 3, the towers shown in the first two figures represent a pair of towers—such, for instance, as those indicated by *a* and *b* in Fig. 3—supposed to be upon opposite sides of the track and about a mile apart, the right-hand one corresponding in position with the tower shown in Figs. 7 to 10, inclusive, and therefore having the parts thereof lettered the same as the parts in said figures, while the corresponding parts in the left-hand tower have the same letters marked "prime," for convenience of description.

Each tower has two track-instruments *c d* and *e f*, of any suitable character, by which the action of the passing train will cause the contact-points of the instruments to separate and thus break the circuit, it being understood that these points are normally in contact and one of them always grounded through the wire *g*.

With the parts in position illustrated in Fig. 1 the targets are invisible. The openings G and G′ show "white" and indicate that there is no train in the block between the signals. We will now trace the primary circuit, beginning with the track-instrument *d* and following the heavy wires, which indicate the primary circuit. Wire 1 connects the track-instrument with the coils of the electro-magnet R, which in turn are connected by wire 2 with a contact-point 3, which latter, with a mate 4, are arranged to be alternately engaged by the armature-tongue *y* of the polarized relay W, which at this time is in contact with point 4. Hence the circuit continues from point 3 by wire 5 to the plus side of the battery, the minus side of which is connected by wire 6 with the point 4, thence through the armature-tongue and by wire 7 to the ground. The direction of flow of the current is indicated by the arrows in this target and also in the left-hand target, in which the primary circuit is traced through exactly the same parts which are there designated by the same characters with prime-marks, except that the position of the parts is reversed, the current flowing from the battery toward the track-instrument *d*, which connects with the plus side of the battery D and toward the battery from the track-instrument *e*, which connects with the minus side of the battery D′. Now, upon a train entering the block from either direction it will pass over the track-instruments *c* or *f* without producing any result, because one of them was last actuated to place the parts in their present position, and can therefore have no effect to change their position; but, assuming that the train enters the block in the direction indicated by the wheel and arrow at the right of the drawing, as soon as it passes over the track-instrument *d* the primary circuit will be broken at that point in the plus side of the circuit momentarily, and thereby produce an electrostatic discharge, or what I will term a "secondary current" of the same sign which traverses the local circuit in the same direction as the primary current; but as the primary circuit is broken at the track-instrument *d* the static discharge, which otherwise would jump across the break in the form of a spark, now passes from the primary circuit into the secondary circuit proper, which will now be traced, beginning with the wire 8, connecting with the primary wire 1 just beyond the magnet R. This wire connects with the spring contact-plate T, and the circuit then continues to block U, through wire 9, to and through the relay-coils W, through wire 10, which constitutes the line to the relay-coils W′ of the other signal on the left, through wire 9′ to block U′ to contact-plate T′, and thence through wire 8′ to the ground, using a portion of the primary wire 1′ and the track-instrument *e* to complete its circuit. It will of course be understood that the passage of this current through all the connections described is practically instantaneous, and that the effect thereof upon the polarized relays, by reason of the direction in which it flows therethrough, is to attract the relay-armatures to the opposite pole, causing the tongues Y Y′ to swing over to the contact-points 3 3′, and thus shunting the primary current from the electro-magnets R R′, which are thus demagnetized, and at the same time diverting the current through (so as to energize) the electro-magnets Q Q′, which now attract the rocking armatures O O′, and through the agency thereof and the connections before described causes the targets H H′ to simultaneously swing over so as the span the opening G G′, and thus cause the signals to show "red," indicating danger, and that the track is occupied between the two signals. The action of the target in swinging over to the position described also breaks contact between the springs T T′ and

the blocks V V′, and permits the spring-contacts S S′ to move into contact with the blocks V V′, and thus form a part of the secondary circuit. The position which the parts assume at this time and retain during the time that the train is within the block is represented in Fig. 2, in which also the primary circuit is indicated by the heavy lines, and the direction of flow of the current by the arrows. As the train continues to move, it will also pass over the track-instrument *e* without having any effect, because the current is now shunted therefrom to the ground through the armature-tongue of the relay; but upon passing over the track-instrument *f* at the other end of the block the circuit through the magnet Q′ will be temporarily broken, producing another static discharge or secondary current of the same sign as the one last described, but which takes directly the opposite direction through the line-wire 10 and both relay-coils, by reason of the changes in the contact-springs S T S′ T′, caused by the different positions of the target-lever, thus: beginning at the juncture of wire 11′ with the primary wire near magnet Q′, through wire 11′ to S′, and U through wire 9′ to and through relay-coils W′ and back over the line-wire 10 to the other relay-magnet W, and thence by wire 9, block U, contact-spring T, and wire 11 to local circuit, thence to the ground through the track-instrument *c* to complete the circuit. It will of course be understood that the sign of the static discharge or secondary current will depend upon which of the track-instruments is employed for breaking the primary circuits, which of course further depends upon the direction in which the train enters the block, and that the breaking of the primary circuit on the plus side of either battery will cause the static discharge to flow in one direction, while the breaking of the primary circuit on the minus side of the same battery will cause the static discharge or secondary current to flow in the opposite direction; but the two primary or local circuits are so arranged with relation to each other that the breaking of the plus side of one battery will have the same effect upon the relays as the breaking of the minus side of the other battery, and vice versa, and hence the track-instruments of the two local circuits are so arranged that regardless of the direction in which the train is moving it will always break the primary circuits successively on the same side of each battery upon entering and leaving a block.

Referring now to the double-track system illustrated in Figs. 4 and 5, it will be seen that each of the signals is composed of the same elements, in the same relative locations, and operating in the same manner as in the single-track system; but as all the trains upon each track always move in the same direction it is unnecessary to throw a signal to the front of a train, but only to the rear, for which reason only one line of signals for each track is employed. These signals, like the signals of the single-track system, work in pairs, but are so connected that each signal successively forms one of two pairs of signals, co-operating first with the next signal to the rear, so as to cause the latter to disappear when the train leaves the block and then co-operating with the next signals to the front, so as to be caused thereby to disappear when the train leaves the block. Thus, while the targets are shown in this drawing as coupled in series, their operation is that of independent pairs, each signal, as before stated, constituting one of two pairs, but operates alternately therewith—that is to say, instead of both signals being thrown, or both being withdrawn from sight simultaneously, as in the single-track system, one signal is thrown and the other simultaneously withdrawn from sight successively throughout the pairs of the series. As a result of this difference in the operation of the two systems, the wiring or circuit between the pairs of signals is necessarily different and more simple. The reference-letters heretofore applied to the main elements may be applied to the same parts in Fig. 4. The primary circuit of each signal of this double-track system is the same, and may be readily traced by following the heavy lines, the arrows in the left-hand target representing the direction of the current when passing through the magnet R′, while the arrows in the middle signal represent the direction of the current when flowing through the magnet Q. It will be observed that there is only one track-instrument for each tower, and that each instrument is connected with the same side of the battery, which might be either the positive or negative pole thereof. Let the wheel between the first and second towers on the left indicate the present position of the train and the arrow the direction in which the train is moving, it will be seen that the left-hand signal-target G′ is visible, indicating that the train is between it and the next target at the other end of the block in the direction in which the trains move on that track, that the armature-tongue of the polarized relay W′ is on the left-hand contact and is grounded, and that the current at this time is flowing through the electro-magnet R′, energizing the same and causing the signal to appear. The parts of this signal will remain in this position until the train passes over the next track-instrument, breaking the primary circuit therethrough and producing the electrostatic discharge, which leaves the primary wire proper at the point Q^2 and traverses the secondary circuit through the relay W, causing its armature-tongue to swing over from the right to the left hand contact, so as to divert the primary current from the magnet Q to the magnet R, after which it passes out over the line and back to the rear or left hand signal, and through the relay W′ thereof, causing its armature-tongue to change from the left to the right hand contact-point,

and thus divert the primary current from the magnet R′ to the magnet Q′, after which the static discharge is grounded through the primary wire and track-instruments of the left-hand magnet. The effect of this action is to cause the target-signal H to become visible or show "red" in the opening of the central target, at which point the train is now, and simultaneously the target H′ of the tower to the rear to become invisible. This operation will be repeated throughout the system, each target successively forming one of a pair with the targets at each side thereof.

The third or right-hand signal illustrates the operation of a tell-tale, which is equally applicable to both the single and double track systems for indicating when a break occurs in the primary circuit or when the battery fails to work for any cause, which tell-tale communicates the fact to the engineers by the target showing "half red" in the opening in the tower, upon seeing which the engineer will proceed with caution until the next tower is reached. This tell-tale is produced by having the contact-springs S T of such a shape that when neither of them is forced to the right or left by the target-arm they will make contact with each other, but not with the block U, each serving to hold the other out of contact with the block. In this manner when both the magnets Q R become demagnetized by the breaking of the primary circuit through them or the failure of the battery to work the target will fall by gravity to a vertical position beneath its supporting-pivot and the upper free end V thereof will stand between without touching either one of the contact-springs S T, but only the individual target whose primary circuit is out of order will be affected by such action, for the contact-springs will serve to complete the secondary circuit, so as to bridge the disabled signal, and thus the last signal operated will be caused to disappear or become invisible in the usual manner when the train reaches the next track-instrument the same as if the idle tower did not exist. Thus it will be seen that any tower whose local circuit may have become inoperative from any cause will be automatically switched out and the line or secondary circuit closed, so as to bridge the idle tower, and hence the system, as a whole, does not become deranged by the inoperativeness of any one or more of the towers, but remains unaffected thereby and perfectly operative. This tell-tale serves to indicate immediately at exactly at which point in the system the battery or primary circuit is out of order, and no testing is required to locate the trouble, thus effecting a great saving of time.

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

1. In a block-signaling system, the combination, with a series of signals, a pair of opposing electro-magnets for operating each signal, and a local circuit therefor, of a secondary circuit connecting each pair of signals and a polarized relay for each signal included in said secondary circuit for shunting the primary current of the local circuit alternately through said electro-magnets, substantially as described.

2. In a block-signaling system, the combination, with a local circuit, a pair of opposing electro-magnets for operating the signal included in said circuit, and a track-instrument also included in the circuit, of a shunting device operated by the breaking of the circuit at the track-instrument for shunting the circuit alternately through said magnets, substantially as described.

3. In a block-signaling system, the combination, with a series of signals, a local circuit for each signal, a pair of opposing electro-magnets for operating said signals included in each local circuit, and a track-instrument for each signal, also included in each local circuit, of a series of secondary circuits connecting said signals in pairs, and a polarized relay for each signal included in said secondary circuit for alternately shunting the local primary current through said electro-magnet, substantially as described.

4. In a block-signaling system, the combination, with a series of signals, a local circuit for each signal, a pair of opposing electro-magnets for operating the signals included in the local circuits, and track-instruments in each local circuit, of a series of secondary circuits connecting the signals in pairs, a polarized relay for each signal included in said secondary circuit for alternately shunting the local primary circuit through said electro-magnets, and a switch device operated by each signal for changing the direction of the current of the secondary circuit through said relays, substantially as described.

5. In a block-signaling system, the combination, with a series of signals, the pivoted targets thereof, a local circuit for each signal, and a pair of opposing electro-magnets included in said circuits, of a rocking armature alternately attracted by said magnets and connected with so as to operate the target and a shunting device for shunting the current of the local circuit alternately through said electro-magnets, substantially as described.

6. In a block-signaling system, the combination, with a series of signals, the targets thereof, a local circuit for each of said signals, a pair of opposing electro-magnets included in each of said circuits, a rocking armature alternately attracted by said magnets and connected with so as to actuate said target, and a track-instrument included in each local circuit, of a series of secondary circuits connecting the signals in pairs, and a polarized relay for each signal included in said secondary circuits for alternately shunt-

ing the current of the local circuit through said electro-magnets, substantially as described.

7. In a block-signaling system, the combination, with a series of signals, the pivoted targets thereof, a local circuit for each signal, a pair of opposing electro-magnets in each circuit, a rocking armature therefor alternately attracted by said magnets and connected with so as to actuate the target, and the track-instrument for each local circuit, of a series of secondary circuits connecting said signals in pairs, a polarized relay for each signal included in said secondary circuits for alternately shunting the primary current of the local circuits through the electro-magnets, and a switch device operated by each target for changing the direction of the current of the secondary circuit through the relays, substantially as described.

MAHLON S. CONLY.

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