4 Sheets--Sheet 1.

T. S. HALL.

Electric Railway Signal Apparatus.

No. 150,030. Patented April 21, 1874.

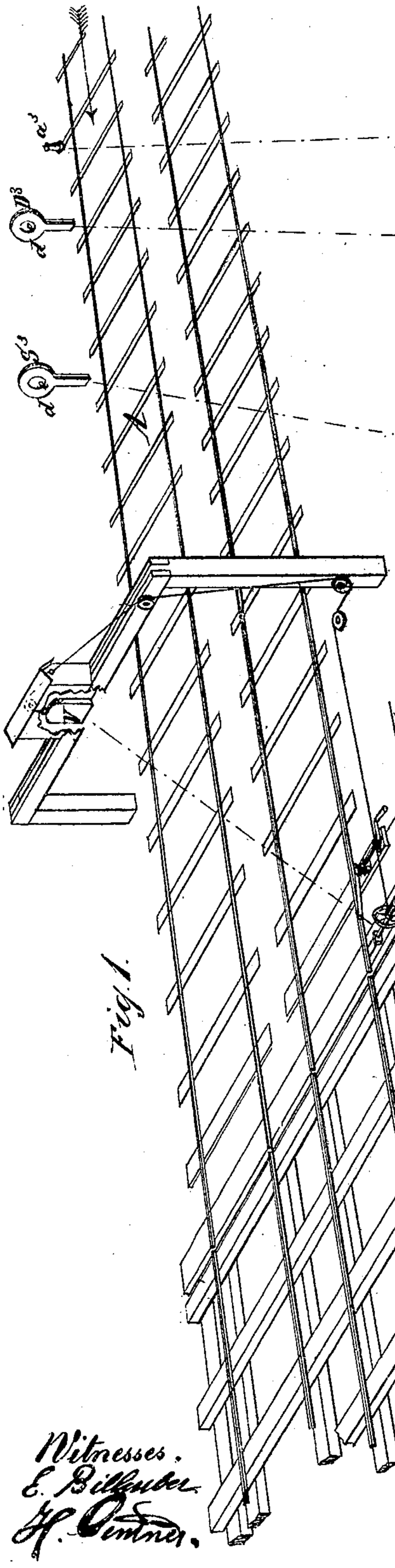

Fig. 1.

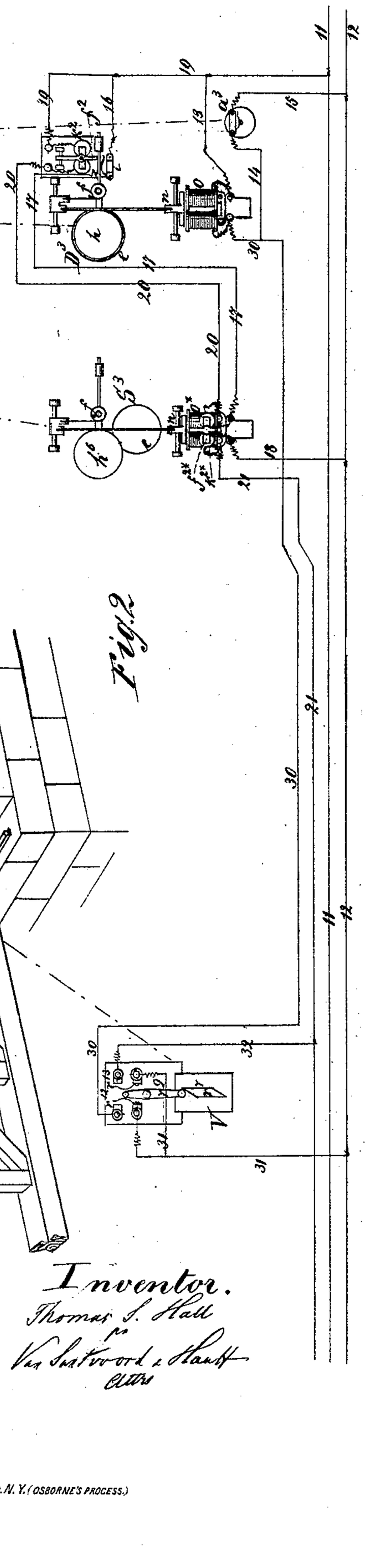

Fig. 2.

Witnesses.
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4 Sheets--Sheet 2.

T. S. HALL.

Electric Railway Signal Apparatus.

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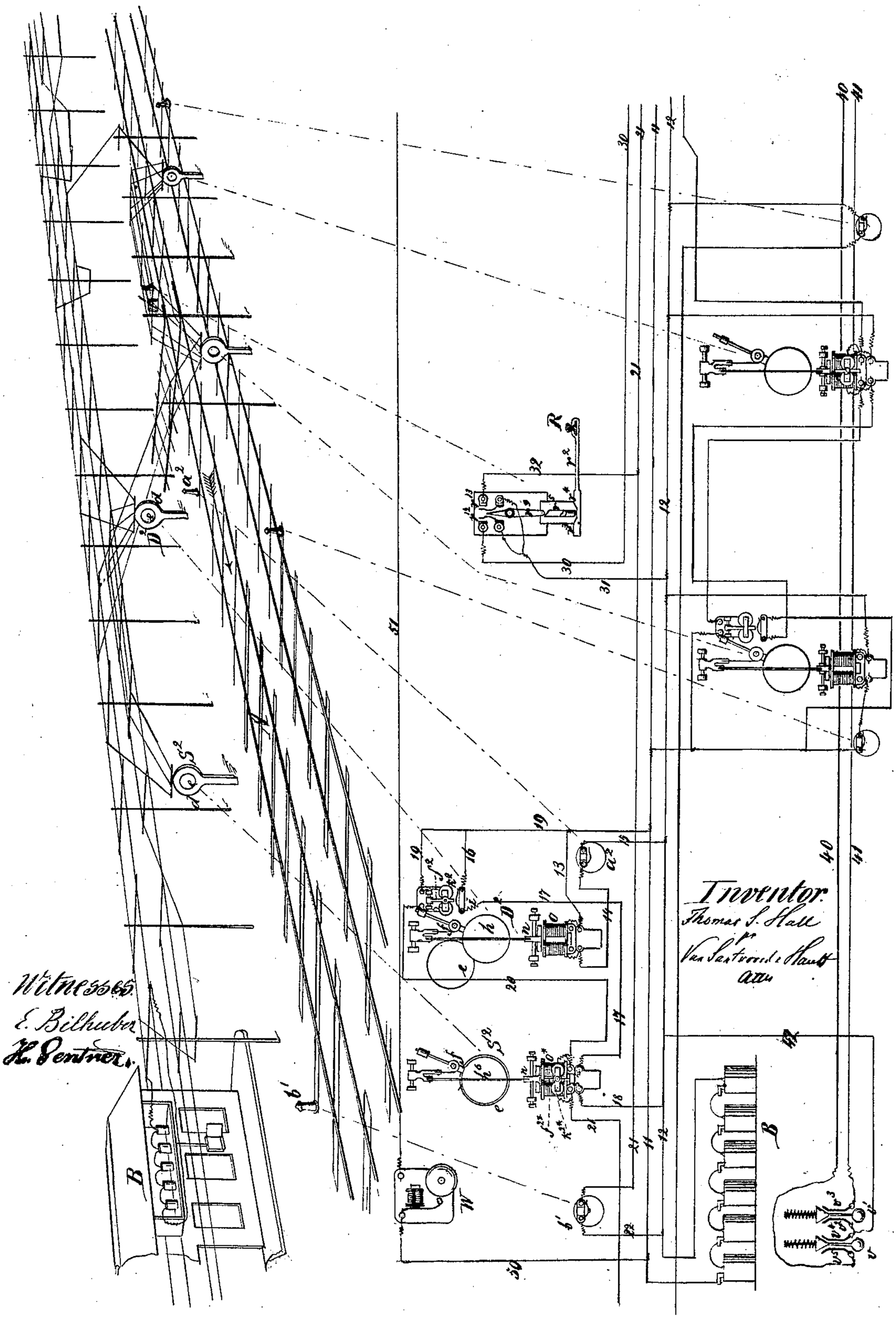
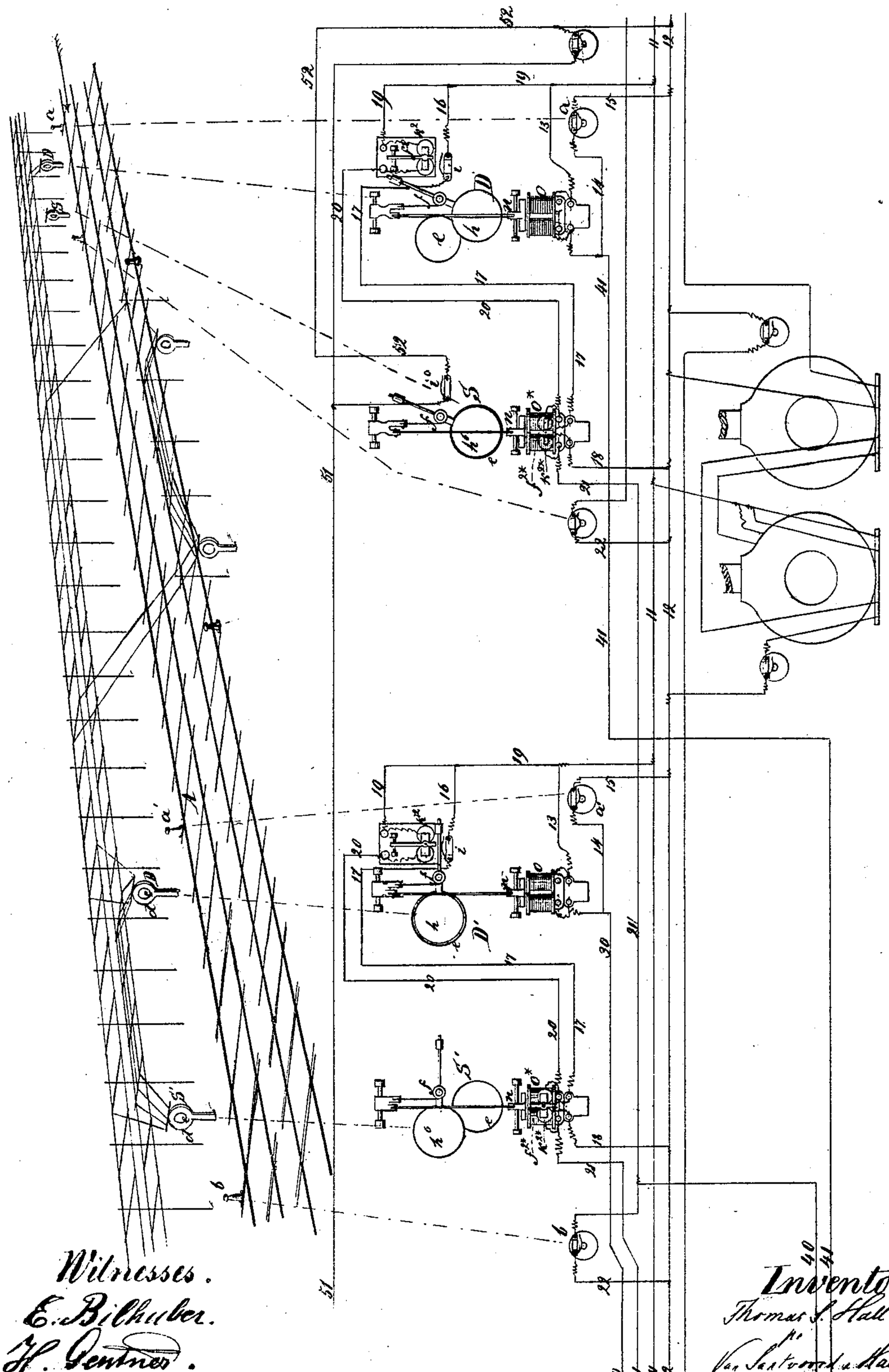


4 Sheets--Sheet 3.

T. S. HALL.

Electric Railway Signal Apparatus.

No. 150,030. Patented April 21, 1874.



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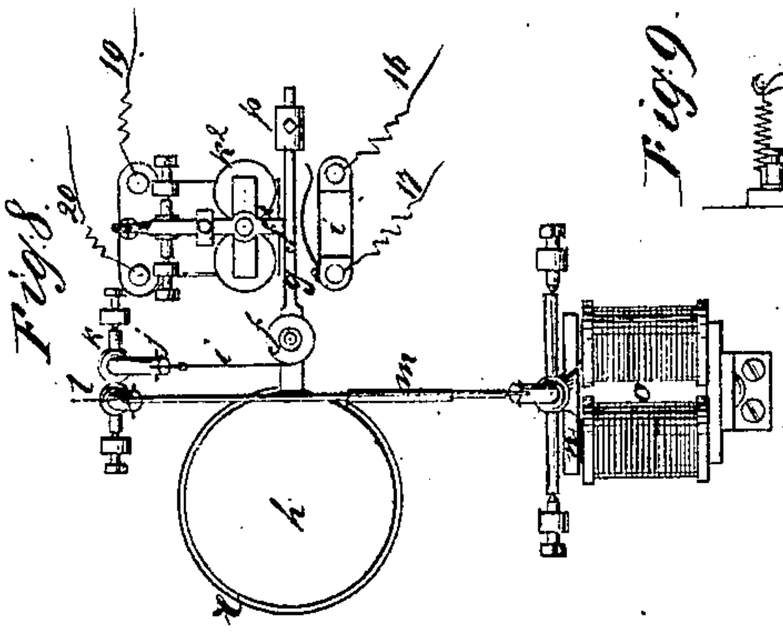
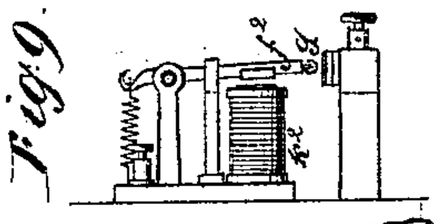
4 Sheets--Sheet 4.

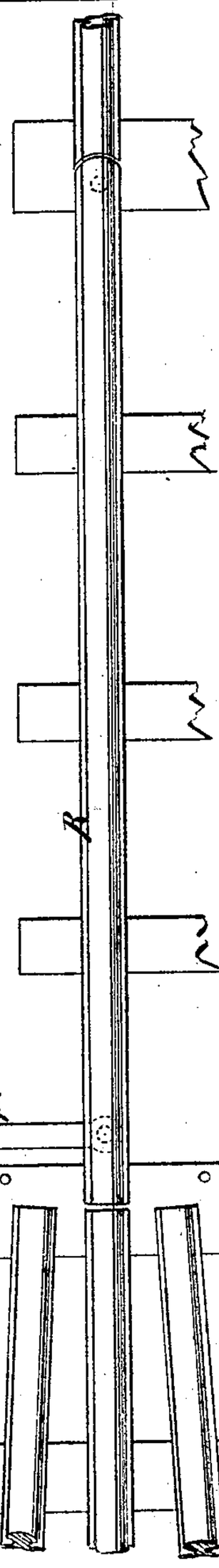
T. S. HALL.

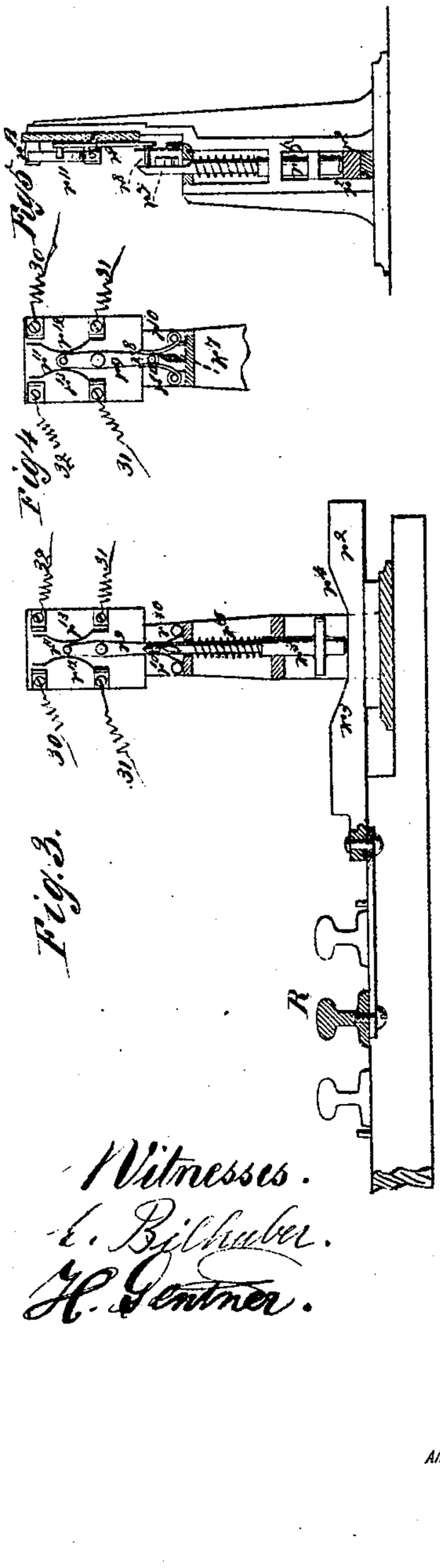
Electric Railway Signal Apparatus.

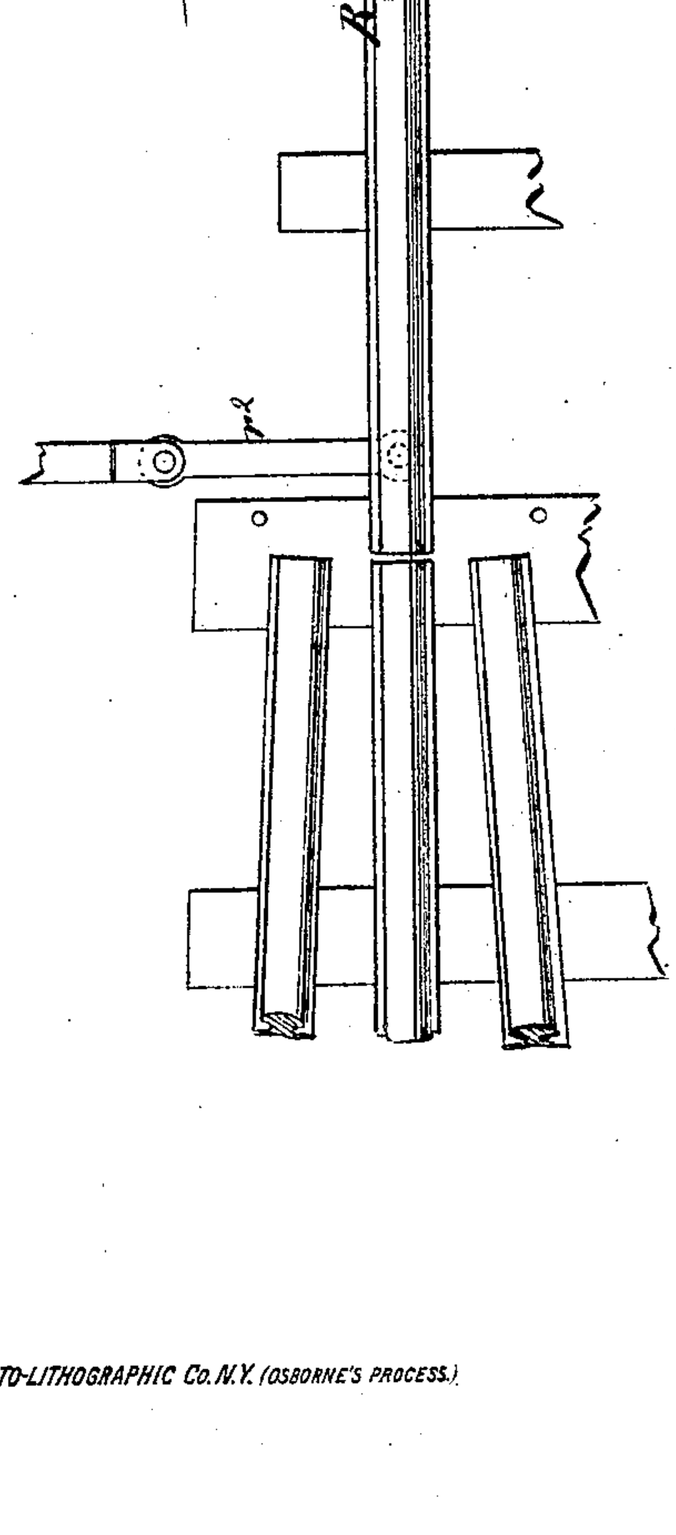
No. 150,030. Patented April 21, 1874.











Witnesses.
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H. Gentner.

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UNITED STATES PATENT OFFICE.

THOMAS S. HALL, OF WEST MERIDEN, CONNECTICUT.

IMPROVEMENT IN ELECTRIC RAILWAY-SIGNAL APPARATUS.

Specification forming part of Letters Patent No. **150,030**, dated April 21, 1874; application filed December 31, 1873.

To all whom it may concern:

Be it known that I, THOMAS S. HALL, of West Meriden, in the county of New Haven and State of Connecticut, have invented a new and useful Improvement in Electro-Magnetic Railroad-Signals; and I do hereby declare the following to be a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which drawing—

Figure 1, extending over Sheets I, II, and III, represents a perspective view of a railroad-track with my signal apparatus. Fig. 2, extending over the same number of sheets, is a diagram illustrating the connections of the signals with each other and the battery. The remaining figures are details, which will be referred to as the description progresses.

Similar letters indicate corresponding parts.

This invention relates to certain improvements in electro-magnetic railroad-signals, described in my patent No. 118,606, dated August 29, 1871; and the invention consists in retaining the signals in the position in which they are brought by electro-magnetism by means of a locking-lever, arranged to act on the tail ends of the signal-shanks, as hereinafter more fully described. The invention also consists in making the rod yielding which extends from the armature of the signal-magnet to the mechanism for turning the signal, so as to prevent injury to the mechanism, and to insure a correct operation. With the continuous line-wires are also combined pairs of signal-houses, the signals of which connect with the danger-signal of a draw-bridge, or with the bar that serves to move switch-rails on a switch, in such a manner that, whenever the draw-bridge or switch is set to allow a train to pass on the main track, the first signal in said pair indicates safety, and the second signal indicates danger, and when the draw-bridge or switch are set so that the approaching train cannot pass on the main track the first signal shows danger, and the second safety.

In the drawings, the letter A designates a railroad-track, on the side of which are placed a series of signal-houses, D S D^1 S^1, &c., which are arranged in pairs, as shown. The signals h h^6, contained in said signal-houses, are operated by the action of the wheels, or any other part of a passing train, on levers a b a' b', &c., which levers, together with their connections, constitute the track instruments. The signal-houses D D^1 D^2, &c., are the main signal-houses; and each of them consists of a box or casing, d, provided with an aperture, e, in the side toward which the signal is to be displayed. On the side of the aperture e rises a stud, f, (see Fig. 8,) which forms the fulcrum for a lever, g, on one end of which is secured the signal-disk h, while on its opposite end is placed an adjustable weight, p. The signals h, contained in the houses D D^1, &c., may be termed the "danger-signals." From the hub of the lever g extends a chain, i, to an arm, j, projecting from a rock-shaft, k, on which is mounted a second arm, l, which connects, by a rod, m, with the armature-lever n of an electro-magnet, o.

If the armature is attracted, the rod m is forced upward, and the signal-lever is turned on its pivot so as to bring the signal-disk h opposite the aperture e, and, consequently, the signal is displayed; but, as soon as the armature of the electro-magnet o is permitted to fall back, the signal-disk, which somewhat overbalances the weight p, will, if not otherwise detained, return, by its inherent gravity, to its original position, and the signal is taken off.

If the armature of the electro-magnet o is suddenly attracted, a very rapid motion is imparted to the signal-lever, whereby the same is caused to rebound, so as to disturb the correct operation of the apparatus; and, furthermore, by this sudden motion the mechanism is liable to wear out very rapidly. This disadvantage I have obviated by constructing the rod m in two parts, (see Fig. 7,) the upper part m^3 of said rod being provided with a tubular socket to receive a spring, m^4, and also the lower section m^5 of the rod. This lower section is retained by a pin, m^6, which passes through a slot in the tubular socket, and through a hole in the section m^5, so that this section can be forced in against the action of the spring m^4, as far as the slot in the tubular socket will permit. The inner end of the spring

m^4 bears against a slide, m^7, which extends transversely through the tubular socket, and moves in a slot provided to receive it. On the edges of the slide m^7 are cut screw-threads, which engage with a thread cut into a sleeve, m^8, that is fitted on the tubular socket, and confined between two collars, m^9 and m^{10}, the upper one of which is held in position by a pin passing transversely through it, and through the tubular socket, near its inner end, while the lower collar m^{10} is soldered to said tubular socket. By turning the sleeve m^8, therefore, the slide m^7 is made to move up or down in its guide-slot, and the tension of the spring m^4 can be regulated as circumstances may require.

The signal-houses S S^1 S^2, &c., are constructed like the signal-houses D D^1 D^2, but the signals h^6 contained in the same, when permitted to follow their inherent gravity, drop down before the aperture *e* in their signal-houses, and, if they are raised by the action of their electro-magnets o^* they disappear out of sight, or, in other words, they show "safety;" while the signals *h* in the houses D D^1 D^2, &c., when actuated by their electro-magnets *o*, show "danger"; and when left to follow their inherent gravity they show "safety." The signals in the houses S S^1 S^2, &c., may, therefore, be termed safety-signals, while those in the houses D D^1 D^2, &c., are termed danger-signals, as previously stated.

The electro-magnets *o* o^* of the signals *h* h^6 are vitalized by the action of the wheels or other parts of a passing train on the track-instruments *a* *b* *a'* *b'*, &c.; and, in order to retain the signals in position for some time after the train has passed, they are locked, by levers *f* f^{2*}, in the following manner: The locking-levers f^2 of the danger-signals *h*, Figs. 2, 8, and 9, are situated in such a position that they act on the tail ends of the signal levers or rods *g*, and they are exposed each to the action of a spring which allows the same to recede as the rods *g* sweep down in front of them, and when the rods have passed the ends of the locking-levers the latter spring back and hold the signals displayed. Each of the levers f^2 is connected to the armature of an electro-magnet, k^2, and the signal *h* is kept displayed until this electro-magnet is vitalized, whereby the lever f^2 is drawn back so as to release the rod of the signal and allow the latter to follow its inherent gravity and to return to its position of safety. The locking-levers f^{2*} of the safety-signals h^6 act directly on the armature-levers *n* of the signal-magnets o^*, and they carry the armatures of the electro-magnets k^{2*}, so that when the armature-levers *n* are locked by the levers f^{2*} the signals h^6 will be retained out of sight, and they will be held in that position until the electro-magnets k^{2*} are vitalized, whereby the locking-levers f^{2*} are caused to release the armature-levers *n*, and the signals h^6 are permitted to follow their inherent gravity, which carries them back to their position of danger.

All the signals on the line are operated by means of one and the same battery, B, which is situated in the depot or station-house at any convenient spot on the road. One pole of this battery connects with a line-wire, 11, and the other with a line-wire, 12, which line-wires extend from one terminus of the road to the other.

If a train moves on the track A in the direction of the arrow shown thereon in Fig. 1, Sheets I, II, and III, and if the wheels of this train strike the lever of the track-instrument *a*, the circuit is closed through the wires 12 and 15, track-instrument *a*, wire 14, electro-magnet *o* of the danger-signal D, Fig. 2, Sheet III, and wires 13, 19, and 11, back to the battery, the electro-magnet *o* is vitalized, and the signal in the house D is raised into sight. The tail end of the signal-lever *g* on striking the spring-key *i*, closes the circuit through wires 11, 19, and 16, key *i*, wire 17, electro-magnet o^* of signal-house S, and wires 18 and 12, back to the battery, the electro-magnet o^* in the house S is vitalized, and the safety-signal h^6 is moved out of sight. The signal *h* is locked in its raised position by the lever f^2, which, however, allows the rod *g* to recede sufficiently far to relieve the key *i*, so that the circuit through the electro-magnet o^* of the safety-signal S is broken as soon as this signal has been moved out of sight. The locking-lever f^{2*} retains the safety-signal in position. As the train proceeds its wheels strike the lever of the track-instrument *a'*, and the signal D^1 is brought in sight, while the signal S^1 is moved out of sight before the positions of the signals D and S are disturbed, Sheet III. When the wheels of the train strike the reversing track-instrument *b* the circuit is closed through the wires 22 and 12 to one pole of the battery, the wire 21, helix of electro-magnet k^{2*}, wire 20, helix of electro-magnet k^2, and wires 19 and 11, to the other pole of the battery, the electro-magnets k^2 and k^{2*} are vitalized, the locking-levers f^2 f^{2*} are caused to release their signals, and the signals in the houses D and S return to their original positions, the former moving out of sight, and the latter in sight, while the signals in the houses D^1 S^1 remain, the former in sight, and the latter out of sight.

From this description it will be readily seen that no collision can take place. If a train should remain standing on the track between the signals S and D^1, the signal D will show danger, and a succeeding train can be stopped easily before any accident arises, since the first train will not take off the danger-signal D until it passes the track-instrument *b*. But if, from some cause, the signals should fail to operate when the train passes the track-instrument *a*, the safety-signal S, instead of being moved out of sight, will remain in sight. It indicates danger, and the engineer, by stopping his train, can readily ascertain the defect.

On a double-track road the signal-houses and track-instruments will be arranged on op-

posite sides of the track, as shown in Fig. 1, and the connections are made as shown in Fig. 2. The same line-wires 11 and 12 connect with the signal-houses on both sides of the track, and the operation of the signals remains the same as above described.

The system of signals hereinbefore described can also be combined with a switch and with a draw-bridge, in the following manner:

The switch-rails R (best seen in Figs. 3 and 6) are connected to a slide, r^2, which is provided with a recess having inclined sides r^3 r^4, as shown in Fig. 3. Opposite to this recess is placed a rod, r^5, which is depressed by a spring, r^6, and which carries a double inclined or diamond-shaped cam, r^7, best seen in Fig. 4. This cam is intended to act on a pin, r^8, which projects from a lever, r^9, that is held in a central position by two springs, r^{10}, acting on it from opposite sides. From the upper end of this lever projects a pin, r^{11}, which is intended to act on two spring-keys, r^{12} and r^{13}, standing on opposite sides thereof. The connection of these keys with the line-wires 11 and 12, and with the signal-houses D^1 S^1, is shown in Fig. 2, Sheets II and III. Both keys r^{12} and r^{13} connect by a wire, 31, with the line-wire 12. The anvil of the key r^{12} connects by a wire, 30, with the helix of the signal-magnet *o* in the house D^1, Sheet III, while the anvil of the key r^{13} connects by wires 32 and 21 with the releasing-magnet k^{2*} of the signal-house S^1, and through this helix of the releasing-magnet and wire 20, helix of releasing-magnet k^2 and wires 19 and 13, with the line-wire 11.

Whenever the slide r^2 is moved either in one direction or in the other, so as to interrupt the main track and make a connection with a side track, one of the inclines r^3 or r^4 raises the rod r^5, and the lever r^9 is turned, so that it presses the key r^{12} up against its anvil. At the moment said key touches its anvil the circuit is closed through wires 12 and 31, key r^{12}, wire 30, helix of signal-magnet *o*, and wires 13 and 19, to line-wire 11, the signal D^1 is turned to its position of danger, and the engineer of an approaching train sees that the main track of the road is not open. Of course, the switch-signal must be distinguished from the ordinary line-signals. As the signal D^1 is brought in sight the signal S^1 is turned out of sight, and the engineer who desires to switch off his train proceeds with safety. The key r^{12} is released as soon as the diamond-shaped cam r^7 of the rod r^5 has passed pin r^8 of the lever r^9, and thereby the battery power is saved, the signals being retained in the meantime by their locking-levers f^2 and f^{2*}.

When the slide r^2 is moved back again to its central position, the rod r^5 descends into the recess of said slide, and the diamond-shaped cam r^7, on passing the pin r^8 in its downward motion, turns the lever r^9, so that the key r^{13} is brought in contact with its anvil. The circuit is then closed through wires 12 and 31, key 13, wires 32 and 21, helix of releasing-magnet k^{2*} in the house S^1, through this helix and wire 20 to helix of releasing-magnet k^2 in house D^1, and through this helix and wire 19 to line-wire 11. By these means the signals D^1 and S^1 are restored to their original position whenever the main track is open for a train.

In a similar manner I have connected the danger-signal V of a draw-bridge with the signal-houses D^3 S^3, Sheet I. In this case the diamond-shaped cam r^7 is secured to one side of said danger-signal, (see Fig. 2, Sheet 1;) and if this signal is lowered said cam turns the lever r^9, so as to close the key r^{12}, and the signal D^3 is brought into sight, while the signal S^3 is moved out of sight, thus showing that the draw-bridge is open. When the danger-signal V of the bridge is raised, the cam r^7 and lever r^9 serve to close the key r^{13}, and the signals D^3 and S^3 are restored to their original position.

In the station-house I have applied two hand-keys, *v* and v^1, Fig. 2, Sheet II. By pulling the key v^1 so that the same forms a metallic contact between the springs v^2 and v^3, the circuit is closed through wires 12 and 42, key v^1, wire 41, Sheet III, helix of signal-magnet *o* in the house D, and through this helix and wires 13 and 19 to line-wire 11. The signal D is brought in sight and the signal S is taken out of sight. By pulling the key *v* a metallic contact is established between the keys v^4 and v^5, Sheet II, and the circuit is closed through line-wire 12, wire 42, key *v*, wires 40 and 21, Sheet III, to the helix of the releasing-magnet k^{2*} in house S, through this helix and wire 20 to helix of releasing-magnet k^2 in house D, and through this helix and wire 19 to line-wire 11, and thereby the signals D and S are restored to their original position.

With the safety-signal S are connected a bell and a circuit-closer, i^0, in such a manner that when the signal D is set at danger and the signal S at safety, either by hand-keys or by an approaching train, the bell will strike at the depot to give notification of the position of said signals. The bell connects by wire 50 with the line-wire 11, and by wire 51 with the circuit-closer i^0, Sheet III, the anvil of which connects by wire 52 with the line-wire 12. A track-instrument, a^0, also connects with the bell W, so that the bell is started by a passing train. By these means the station-master is enabled to arrest an approaching train, so as to prevent the same from running into a train that may be detained in the station.

From this description it will be seen that one single battery serves to operate all the signals, whereby the cost of the apparatus and the expense of operating the same are materially reduced; and, furthermore, by the combination of the safety-signals with the danger-signals, the system is rendered safe under all circumstances.

By the action of the gravitation the danger-signals are made to show safety and the safety-signals to show danger. By the action of electro-magnetism the danger-signals are made to show danger and the safety-signals to show

safety. If, therefore, from any cause, the battery used should become inoperative, gravitation would cause the safety-signals to act as signals of danger, and the safety of the train would be insured. If, however, by the breaking of the wires, the electro-magnetism should act only to display the signal of danger, without taking it off, the worst possible result that would occur would be a slight delay; but all head and rear collisions are effectually prevented.

On account of the absolute safety of a road supplied with my system of signals, the trains can be run more rapidly and in quicker succession than they can be on roads without such signals, and the business of the road can be materially increased.

What I claim as new, and desire to secure by Letters Patent, is—

1. The arrangement of a locking-lever, *f*, acting directly on the signal-lever *g*, substantially in the manner shown and described.

2. The arrangement of a yielding rod, *m*, made in sections m^3 m^5, which are acted on by a spring, m^4, said rod forming the connection between the armature-levers *n* and the signal-lever *g*, substantially as and for the purpose set forth.

3. The diamond-shaped cam r^7, in combination with the slide r^2, switch-rails R, lever r^9, keys r^{12} r^{13}, and signals D S, substantially in the manner shown and described.

4. The diamond-shaped cam r^7, in combination with the danger-signal V of a draw-bridge, and with a lever, r^9, keys r^{12} r^{13}, and signals D S, substantially in the manner set forth.

This specification signed by me this 2d day of December, 1873.

THOMAS S. HALL.

Witnesses:
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ALVAH W. HALL.