2 Sheets--Sheet 1.

F. L. POPE.

Electric Railway Signals

No. 149,152. Patented March 31, 1874.

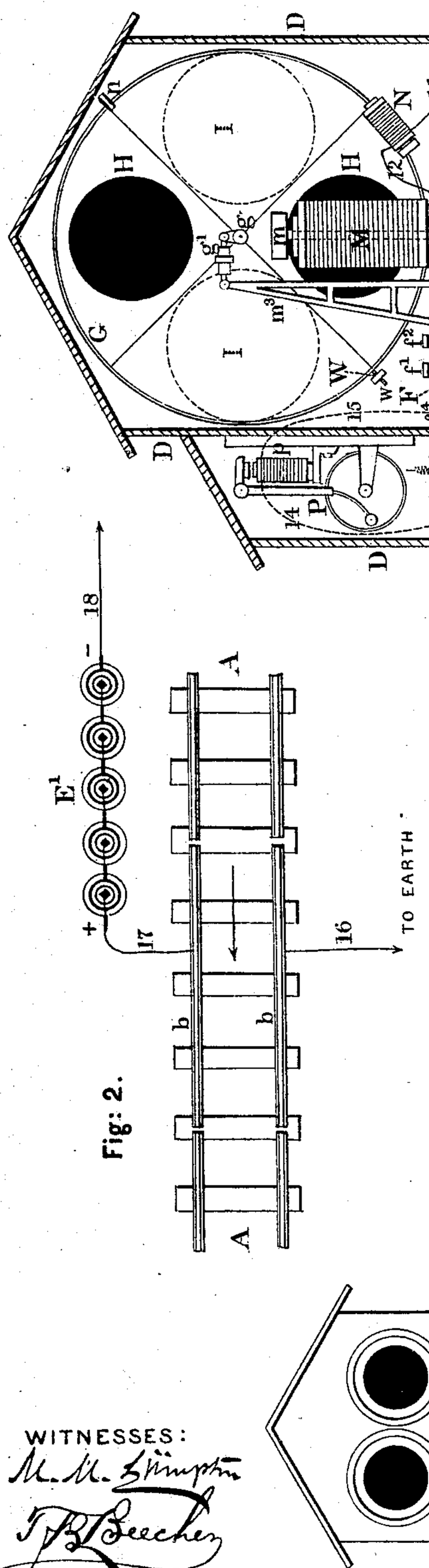

Fig: 2.

Fig: 1.

WITNESSES:

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T. B. Beecher

INVENTOR:

Frank L. Pope

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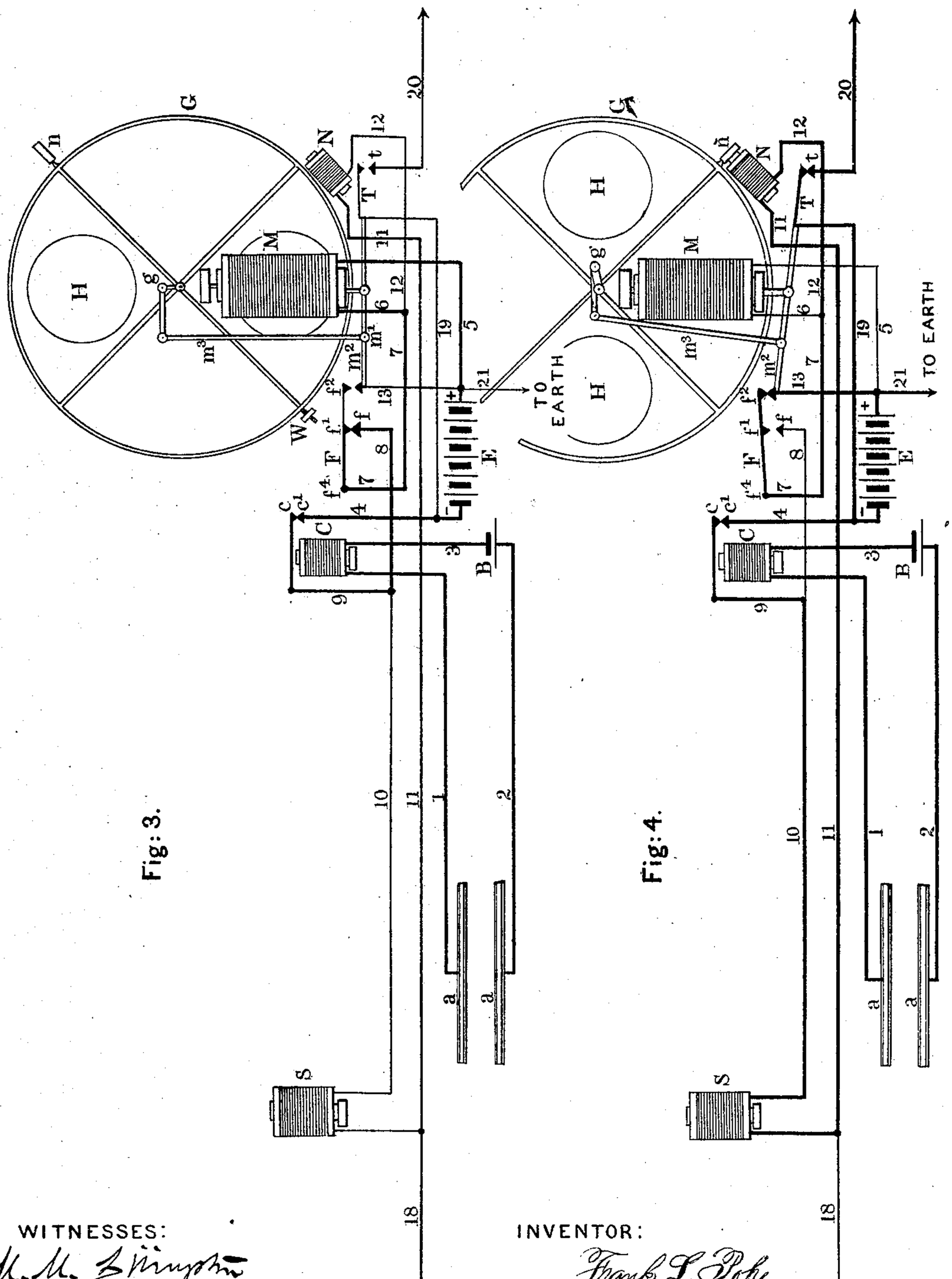

Fig: 3.

Fig: 4.

WITNESSES:

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Frank L. Pope.

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, NEW JERSEY.

IMPROVEMENT IN ELECTRIC RAILWAY-SIGNALS.

Specification forming part of Letters Patent No. **149,152**, dated March 31, 1874; application filed December 21, 1872.

To all whom it may concern:

Be it known that I, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Electric Signaling Apparatus for Railroads; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, which forms part of this specification.

My invention relates to certain improvements in electric signaling apparatus for railroads, and means of operating the same, for which United States Letters Patent No. 129,425 were granted to me July 16, 1872. The object of my present invention is to so arrange a series of semaphoric and audible signals, actuated by electro-magnetism at intervals along the line of a railroad, that each of the said signals will be automatically exhibited by the passage of a train, and will remain visible until the train is under the protection of the next succeeding signal, when the first-mentioned signal will be withdrawn, by which means one train following another upon the same track may be prevented from approaching too closely to the preceding train, or coming in collision with it. My invention consists in certain improved methods of combining and arranging the circuit-closers, wires, batteries, signals, and signal mechanism, whereby greater efficiency and economy of operation are secured.

In the accompanying drawing, Figure 1 is a general view, showing a primary and a secondary signal, and also their electrical connections with each other and with the railroad-track, the box or case inclosing the primary signal being shown in section. Fig. 2 is a detached view, showing the manner in which the battery for releasing or reversing the primary signal may be connected with the railroad-track. Figs. 3 and 4 are diagrams, showing the electrical connections corresponding with the two different positions of the primary signal.

A A represent a portion of the line of a railroad. A short section, *a a*, of the track, is insulated from metallic contact with the remainder by spaces *a' a' a' a'*, or otherwise. The two rails *a a*, when bridged by the wheels and axles of a passing locomotive or car, complete an electric circuit, which includes the wires 1, 2, and 3, the battery B and the helices of the relay C, so that, during the passage of a locomotive or train over the insulated section of track *a a*, the relay C will continuously close a second circuit by bringing the lever *c* into contact with the post *c'*, in a manner well understood. The relay C is placed in a compartment of the box or case D, which also contains the primary signal. The box or case D is mounted upon a suitable support above or alongside the track, and is supposed to be situated at the distance of not less than an ordinary train's length in the rear of the insulated section of track *a a*. Thus, in Fig. 1, the trains are supposed to move from east to west, in the direction indicated by the arrow. The case D, containing the primary signal and its attachments, should be placed at least a train's length east of the point *a a*, for reasons hereinafter to be explained.

When the relay-lever *c* is brought in contact with the post *c'* a second circuit is closed, which includes the wires 4, battery E, wire 5, electro-magnet M, wires 6 and 7, lever F, screw f^1, post *f*, and wires 8 and 9. The course of these two circuits is plainly shown by the heavy lines in Fig. 3. When the circuit is closed at *c c'*, the electro-magnet M becomes charged and attracts the armature *m*, which is attached, by means of a rod, (shown by dotted lines,) to the lever m^2, having its fulcrum at m^1. A rigid arm, m^3, fixed to this lever, revolves the signal-disk G by means of the crank *g* and pitman *g'*, as more fully explained in my former patent of August 27, 1872, No. 130,941. In my present invention, however, I prefer to make use of a single disk, G, having two targets, H H, of some suitable strongly-contrasting color, arranged upon it in such a manner that one-fourth of a complete revolution of the disk G will cause the targets H H' to be displayed through circular openings I I in the case D. (Indicated by the dotted lines.)

It will therefore be understood, without further explanation, that when the electro-magnet M is charged, the armature *m* will be attracted and the disk G turned through the distance of one-fourth of a revolution, thereby

displaying the targets H H through the openings I I.

In order to move the signal-disk G in a prompt and effective manner, by means of an electro-magnet, it is necessary to construct it of very light and thin material, such as cloth or paper stretched over a hoop. It is also necessary to inclose it on all sides with a case, D D, provided with suitable openings I I, as hereinbefore explained, through which the signals are exhibited. These openings should be covered by glass. The object of this arrangement is to prevent currents of air from interfering with the movement of the signal, so that a much smaller battery-power is required than would be necessary if the signal were exposed to the action of the wind.

S is a secondary signal, which may be of any suitable construction. It is also inclosed in a suitable case, and actuated by an electro-magnet, and it should be so arranged that when in its normal condition a color indicating "danger" or "caution" will be exhibited; but whenever the actuating-magnet is charged the color will be changed so as to indicate safety. For example, the normal color exhibited may be green, but the electro-magnet, when charged, may exhibit a white signal. When the circuit is broken, the green is again shown. This secondary signal is to be placed a short distance to the west of the insulated section of track, on the assumption that the train is to run from east to west, as before, for a purpose to be hereinafter explained.

The secondary signal S is actuated as follows: The lever or circuit breaker F is pivoted at f^4, and in its normal position is supported by the screw f^1, which rests upon the post f; but when the armature m has nearly completed its stroke, as hereinbefore explained, the extremity of the lever m^2 comes in contact with the screw f^2, forming an electrical connection at that point, and at the same time raising the lever F and breaking contact between f and f^1. The effect of this is to transfer the current of the battery E from the electro-magnet M to the electro magnet N and the magnet of the secondary signal S, both of which latter are included in the same circuit. The current will now take the path shown by the heavy lines in Fig. 4, which may be traced as follows: Commencing at the negative or — pole of battery E; thence through wire 4, post c', lever c, wires 9 and 10, secondary signal S, wire 11, electro-magnet N, wires 12 and 7, lever F, screw f^2, and wire 13 to the positive or + pole of the battery.

The object of this arrangement of circuits is threefold: First, the cutting off of the current from the signal-magnet M before the completion of the stroke prevents the violent shock to the apparatus, which would otherwise result from the greatly-increased attractive power exerted by the magnet at the end of the stroke when the armature is nearly in contact with the poles. Second, the electro-magnet N is thrown into circuit, and the momentum of the disk G, after the circuit through M is broken, is sufficient to bring the lug or armature n attached to its circumference into contact with the magnet N, and the attractive force of the latter exerted upon the lug or armature n serves to firmly lock the signal-disk G in its new position, and at the same time to prevent any recoil or vibration. Third, nearly the whole power of the battery E is thrown into the magnet of the secondary signal after the primary signal has performed its office, and not otherwise, and the secondary signal thereby becomes an infallible indicator of the movements of the primary signal.

An alarm bell or vibrator, P, operated or controlled by an electro-magnet, p, may be employed in connection with the primary signal, and operated by the same relay C and a section of the battery B. Upon closing the relay a branch circuit will be formed through the wires 4, 14, and 15, which will include the magnet p.

The manner in which the apparatus is operated by the passage of a locomotive or train will now be explained: When the front wheels and axle of the locomotive pass onto the insulated section of track a a, the signal-disk G is turned, as hereinbefore explained, and the targets H H displayed through the openings I I indicating "danger" or "caution;" but as this signal is situated a train's length or more in advance of the insulated section of track, the signal will not be displayed until the entire train has passed it. The movement of the secondary signal S will, however, indicate to the engineer of the train whether or not the primary signal has been properly displayed. I will here remark that the secondary signal should be so placed as to be in plain sight from the locomotive as it passes over and beyond the insulated section of track a a. During the time that the entire train is passing over the section a a, the apparatus will remain in the position last described; but when the last car has passed off from the insulated section, the circuit of the relay C, and consequently that of the electro-magnet N, and also that of the secondary signal S, is broken, and the latter returns to its former position. It is necessary, however, that the primary signal should continue to indicate danger or caution until the train which displaced it has reached a certain point in advance, which point may be either a terminus or another signal station, in order to warn any following train that the track is occupied. I preferably accomplish this by simply allowing the armature n to come in direct and absolute contact with the poles of the electro-magnet N, and making use of the residual magnetism, which will thus remain in the cores and armature after the circuit is broken to retain the armature and consequently the signal-disk G in position. It is generally preferable to make this armature of hardened steel instead of the soft iron ordinarily employed for this purpose.

When the train reaches the next signal-point,

in the direction in which it is moving, it is made to release or reverse the signal, as follows: An insulated section of track, *b b*, Fig, 2, similar in all respects to *a a*, is provided. One rail is connected to the earth by the wire 16, and the other to a suitable battery, E′, by the wire 17. A wire, 18, from the other pole of the said battery, is extended in a direction parallel, or nearly so, with the line of railroad to a point near the secondary signal, S, where it is joined to the wire 11. This wire may be supported and insulated in the same manner as an ordinary telegraph-line. The distance between the points connected by the wire 18 is immaterial, and may be made greater or less, according to the distance that it is desired to preserve between trains following each other upon the track A A. When the circuit at *b b* is closed, a current from the battery E′ will traverse the wires 18 and 11, Figs. 1 and 4, magnet N, wires 12 and 7, lever F, screw f^2, wire 13, and wire 21, to the earth, returning through the earth and wires 16 and 17. The battery E′ must be so placed that its current will traverse the magnet N in a direction opposite to that of the battery E, which will cause the current from E′ to neutralize or destroy the residual magnetism in N and release the armature *n*. The weight W will thereupon cause the signal-disk G to return to its original position, concealing the targets H H, and indicating to the engineer of the following train that he may proceed with safety.

Any other suitable arrangement of conductors to constitute a signal-reversing circuit, so arranged as to be closed by a passing locomotive or car—as, for instance, by the depression of a lever between or near the rails of the track—may be employed in lieu of the insulated section of track *b b*, because only a momentary current is required to release the armature *n* for permitting the signal to return to its normal position.

The weight W is adjustable upon a small spindle, *w*, and is placed upon the periphery of the signal-disk G. It should be sufficient to slightly overbalance the weight of the armature *n*, and to cause the signal to return to its original position when the attraction between N and *n* is destroyed. When placed upon the periphery of the disk in this manner, a very small weight is sufficient to accomplish this result, and much friction is thereby avoided.

Where there is a series of signals of this kind established, I prefer to arrange the mechanism so that the displaying of any one signal will release or reverse the one next in order behind it. I do this by means of a circuit-closing spring-arm, T, attached to the lever m^2, but electrically insulated therefrom in any suitable manner. Whenever the signal is displayed, the arm T is brought in contact with the screw-stud *t*, and a circuit established, either from the battery E, as shown in the drawings, or, if preferable, from a separate battery, through the wires 19 and 20, running back to the next signal in order, and releasing it in the manner hereinbefore described. It may be preferable in some cases to attach the arm T to the mechanism of the secondary signal, or to the relay-lever *c*. These variations, however, are immaterial. It is only essential that the train should be fully under the protection of one signal before the succeeding one is released or reversed, and, therefore, the releasing-current should not be transmitted until the locomotive has reached the point *a a*, which will insure its protection by the signal rearward of the train.

It is sometimes preferable to operate the alarm D by a relay placed in the circuit of the wire 19 or 20, in which case the alarm will be caused to sound continually as long as the primary signal is displayed. In some cases it may also be preferable to arrange the signal-disk so that the danger-signal may be concealed by the action of the electro-magnet and displayed by the action of the counterbalancing-weight W; and this may be done without in any manner changing the general principle upon which the signal is operated. When the section of track *a a* is sufficiently well insulated for the purpose, it will sometimes be found more convenient to operate the electro-magnet M by placing it directly in the same circuit with the said insulated section *a a*, without the use of the relay C, in a manner well understood by those skilled in the art.

I here remark that I do not desire to confine myself to the particular device hereinbefore described for retaining the primary signal in position or action after the circuit is broken. Other devices may be employed for this purpose, such as a catch or latch acting upon the lug or armature *n*, which might be lifted by an additional magnet placed in the circuit of the wire 18; but I prefer the device herein described, as it is more simple in construction and less liable to get out of order than any other.

I do not herein claim, in general, the use of the rails of a railroad-track as a portion of an electrical circuit for operating a signal; neither do I claim the devices shown for transmitting the motion of the armature *m* to the signal-disk G; nor the retaining of a signal in position after the circuit is broken by the force of residual magnetism; nor the releasing of the said signal by means of a current of reverse polarity, as these devices are all shown in my former United States Patents of July 16, 1872, No. 129,425, and August 27, 1872, No. 130,941. I furthermore make no claim to the method herein described of inclosing an electric signaling apparatus in a case with openings therein, through which the signals are exhibited.

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

1. The combination of the following elements: A signal-disk, moved in one direction by an electro-magnet, and in the other by a weight or its equivalent; an electric circuit including

said electro-magnet, and which is only closed by and during the passage of a locomotive or train; and a lug secured to the signal-disk, and acted upon by a holding or retaining device or power, whereby the said disk will be kept displayed after the said circuit shall have been broken, substantially in the manner and for the purpose specified.

2. The combination of the following elements: An insulated section, *a a*, of a railroad-track, forming part of an electrical circuit, including an electro-magnet which controls the movements of a visual or semaphoric signal; a visual or semaphoric signal moved in one direction by an electro-magnet and in the other by a weight or its equivalent; mechanism for retaining or locking the said signal in position against the action of the said weight or its equivalent; a second circuit-closer, *b b*, operated by a passing locomotive or car; and a wire or conductor, 18—the said elements being so arranged relatively to each other that a locomotive or train passing over the insulated section *a a* will cause the signal to be displayed, and to remain displayed until the said locomotive or train has closed the second circuit at *b b*, when the said signal will be released or reversed, so as to assume its normal position, substantially as and for the purpose herein specified.

3. The combination of the following elements: A signal-disk, provided with a counterbalancing device, so as to automatically either display or conceal itself; an electro-magnet for causing the said signal-disk to be displayed or concealed, said magnet being included in an electrical circuit which is under the control of a locomotive or train; and suitable mechanism for retaining or locking said signal against the action of its counter-balance—such mechanism being operated by a second electrical circuit distinct from the first, substantially in the manner and for the purpose specified.

4. The combination of a primary and a secondary signal, each included in and operated by a separate or distinct branch of the same circuit, with a circuit-breaking device, F, arranged and operated substantially in the manner and for the purpose specified.

5. The combination of the signal-magnet M with the circuit-breaking device F, arranged to cut off the current from the magnet M before the completion of the stroke, substantially as and for the purpose herein specified.

6. The combination of the electro-magnet N and its armature *n* with the signal-disk, substantially as and for the purpose herein specified.

7. The arrangement of the primary signal upon the line of a railroad at the distance of a train's length or more in the rear of the circuit-closing device which actuates said signal, substantially as and for the purpose herein specified.

8. The arrangement of the circuit-closing device which actuates the primary signal upon the line of a railroad in the rear of the secondary signal, substantially as and for the purpose herein specified.

9. The combination of the following elements: A visual or audible signal, moved in one direction by an electro-magnet and in the other by a weight or its equivalent; a device for releasing, reversing, or stopping said signal or signals, operated or controlled by an electro-magnet; a line-wire, 18 or 20, including said electro-magnet; and a circuit-closer, T, attached to and operated by the mechanism of a primary or secondary signal, substantially as and for the purpose specified.

10. The arrangement of the circuit-closing device T, relatively to the insulated section of track *a a* and the primary signal, so that any one of a series of signals cannot be released or reversed until the train is under the protection of a succeeding signal, substantially as herein specified.

11. The combination of the following elements: A primary circuit composed of the conductors 1, 2, and 3, and the rails *a a* of a railroad-track connected thereto, so arranged that the said circuit will be completed by establishing a metallic connection between two of the said rails, insulated from each other; a secondary circuit, operated or controlled by a relay, C, placed in said primary circuit; a visual or semaphoric signal, G, and an electro-magnet, M, substantially as and for the purpose herein specified.

12. The combination of the following elements: A primary circuit, composed of the conductors 1, 2, and 3, and the rails *a a* of a railroad-track connected thereto, so arranged that said circuit will be completed by establishing a metallic connection between two of the said rails insulated from each other; a secondary circuit, operated by a relay, C, placed in said primary circuit; and an audible signal, P, under the control of an electro-magnet, substantially as specified.

FRANK L. POPE.

Witnesses:
M. M. LIVINGSTON,
T. B. BEECHER.