(No Model.) 3 Sheets—Sheet 1.

F. L. POPE.

ELECTRICAL SIGNALING APPARATUS FOR RAILROADS.

No. 303,589. Patented Aug. 12, 1884.

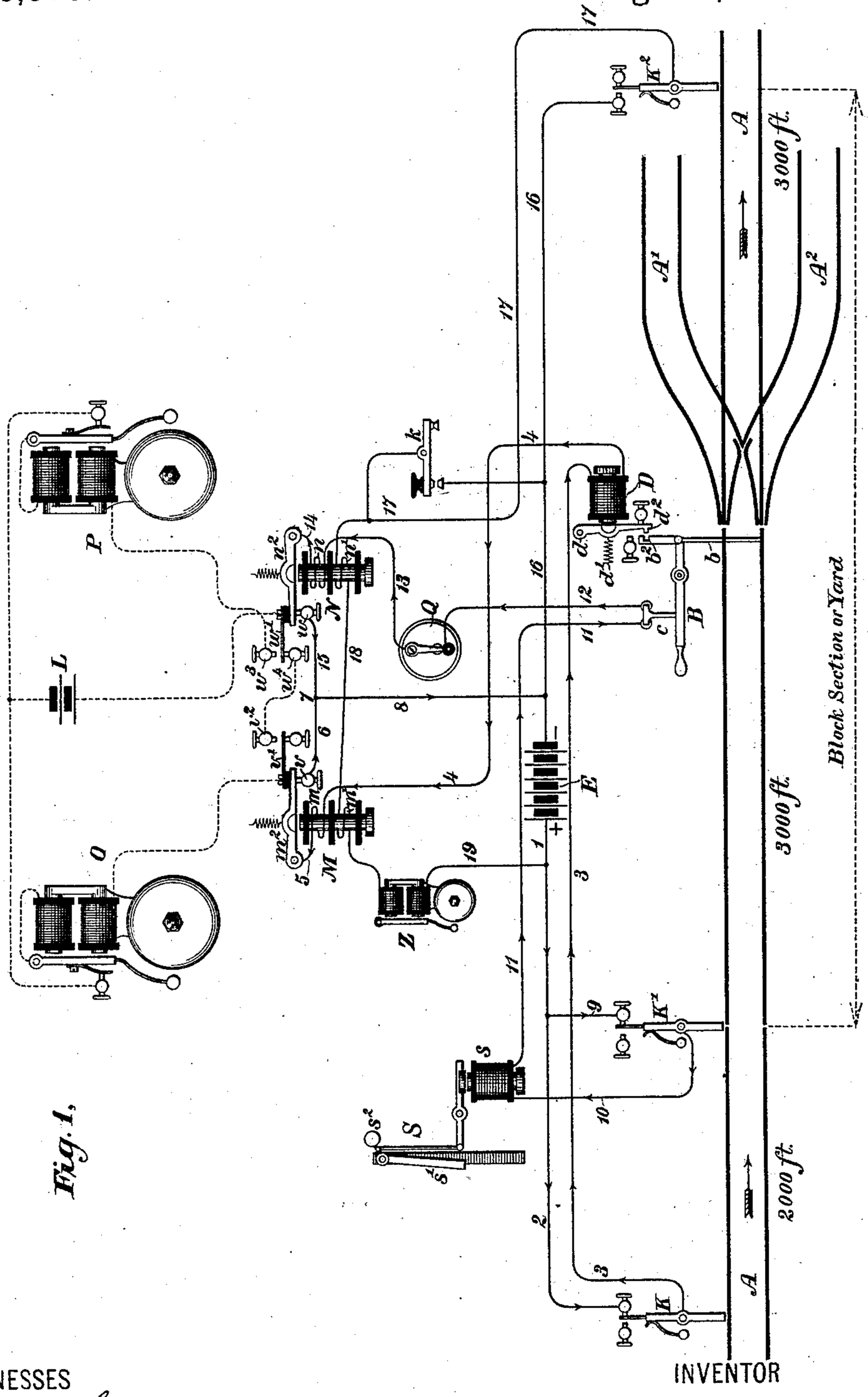

Fig. 1.

WITNESSES

Wm A. Skinkle

Carrie E. Ashley

INVENTOR

Frank L. Pope,

By his Attorneys

Pope Edgecomb & Butler.

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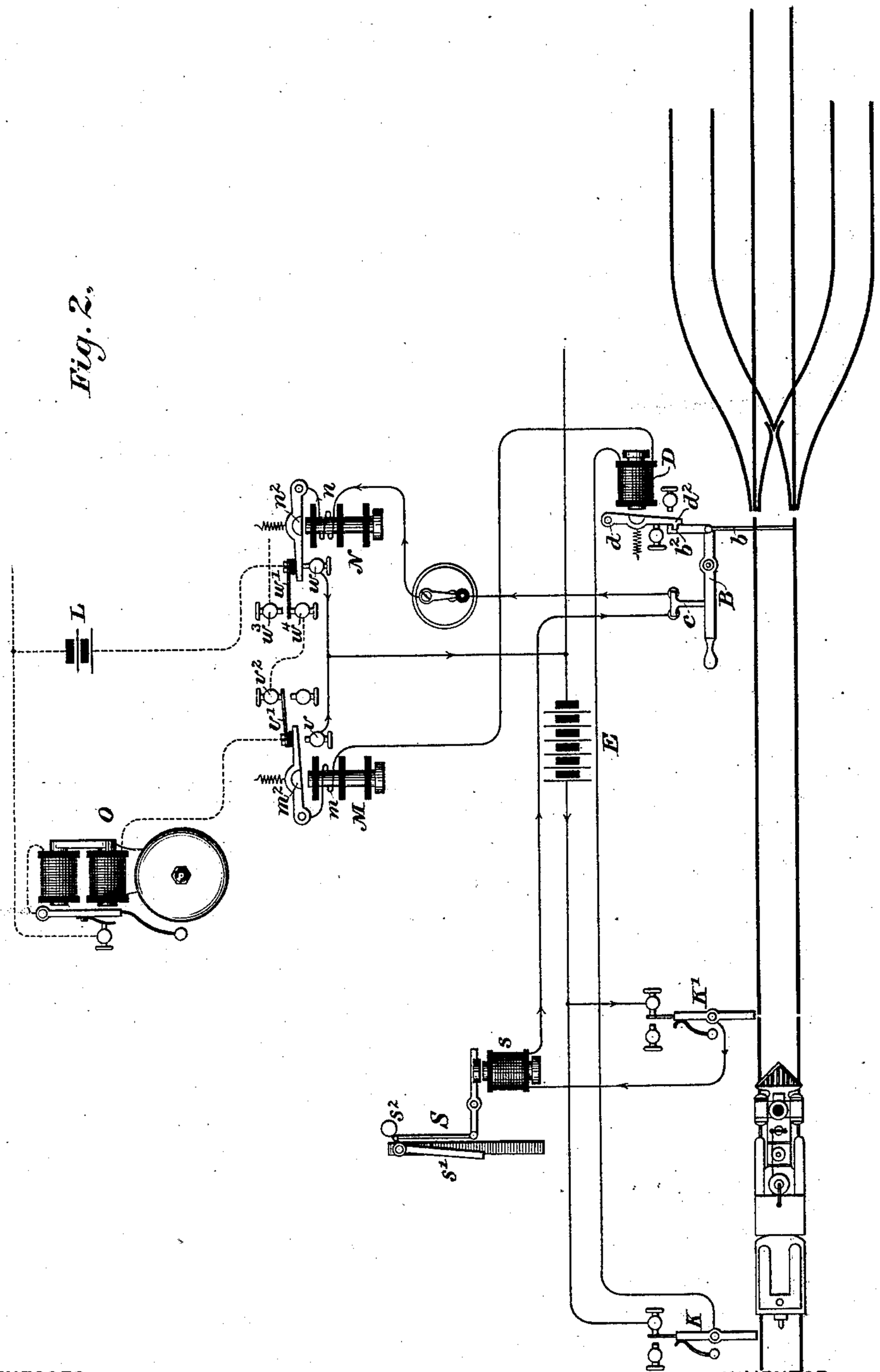
Fig. 2.



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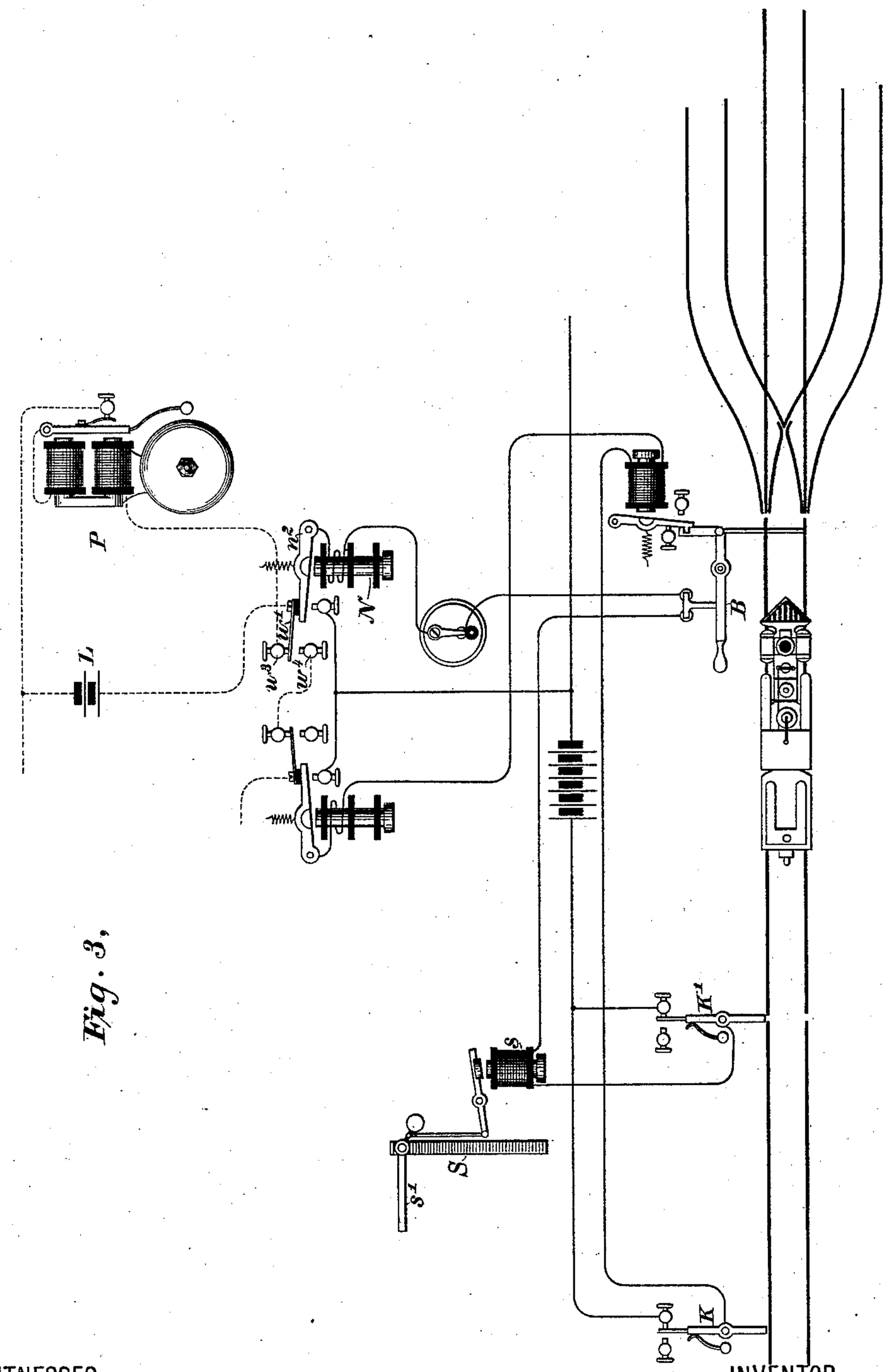

Fig. 3,

WITNESSES

Wm A. Skinkle

Carrie E. Ashley

INVENTOR

By his Attorneys *Frank L. Pope,*

Pope Edgecomb & Batley

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, NEW JERSEY, ASSIGNOR TO THE UNION SWITCH AND SIGNAL COMPANY, OF PITTSBURG, PENNSYLVANIA.

ELECTRICAL SIGNALING APPARATUS FOR RAILROADS.

SPECIFICATION forming part of Letters Patent No. 303,589, dated August 12, 1884.

Application filed September 24, 1883. (No model.)

To all whom it may concern:

Be it known that I, FRANK L. POPE, a citizen of the United States, and a resident of Elizabeth, in the county of Union and State of New Jersey, have invented certain new and useful Improvements in Electric Locking and Signaling Apparatus for Railroads, of which the following is a specification.

My invention relates to a system of electric switch-locking apparatus, in connection with visual and audible signals, designed for the protection of trains at railroad stations or junctions; and it consists in an improved organization of locking apparatus in association with suitable visual or audible signals, either or both, which latter are included in electric circuits and controlled by circuit-closers and circuit-breakers, the latter being in some instances actuated automatically by the passage of a locomotive or train, and in others by the displacement of switches from the main line at sidings or junctions, and in still other cases they may be actuated manually by the station-master or switchman. In accordance with my invention, an approaching train, when at a distance of a mile (more or less) from the station or junction, gives warning of its coming by the ringing of an electric bell at or near the station, and simultaneously secures against displacement all the switches at the junction or in the vicinity of the station by means of suitable electric locking apparatus controlled by the train. After the train has proceeded far enough to pass within the limits of the station-yard or block-section a danger-signal is exhibited in the rear of the train, and at the same moment a second electric bell is set ringing at the station, which continues to sound as long as the signal is displayed. By this means the train while passing through or stopping at the station is protected in its rear by the danger-signal; but as it passes out of the station-yard or block-section, or at a point situated a suitable and proper distance beyond the station, automatic devices actuated by the train serve to withdraw the danger-signal at the entrance of the station-yard or block-section and to unlock the switches. Means are provided whereby the danger-signal at the entrance of the station-yard or block-section may be exhibited or withdrawn at will by the station-master or switchman, in case it is, for any reason, desired to prevent a train from entering; and means are also provided whereby the said danger-signal is in like manner automatically displayed by the displacement of any of the switches in the vicinity of the station, so as to endanger the passage of trains on the main track. The apparatus is, moreover, so organized and constructed that a danger-signal will infallibly be exhibited and an alarm simultaneously sounded in case any of the electric conductors are broken or otherwise interrupted, or in the event of a failure of the actuating voltaic battery to perform its proper functions.

In the accompanying drawings, Figure 1 is a diagram representing my invention, and showing the normal position of the various parts of the apparatus when the track through the station-yard is clear for the passage of a train before the arrival of such train. Figs. 2 and 3 are diagrams showing the position which the apparatus assumes at different times during the passage of a locomotive or train through the station-yard.

In the figures, A A represents the main track extending from one end to the other of the station yard, and A′ and A² are side tracks or branches diverging therefrom at or near the station. The trains are assumed to move over the track A A in the direction indicated by the arrows, and I remark that the apparatus herein shown and described is designed to be applied in connection with one track only of a double-track line of railway, on which track the trains ordinarily run always in the same direction, an entirely distinct set of signaling apparatus, in all respects similar to that hereinafter to be described, being applied to the other track, on which the trains run in the opposite direction. The section of track A A represented in the figures may with advantage be about eight thousand feet (more or less) in length, extending, say, about five thousand feet from the switches in the direction from which the train approaches, and about three thousand feet in the opposite di-

rection. At a suitable and convenient point—say about five thousand feet in advance of the station or junction—is placed a circuit-breaker, K, of well-known construction, which is so situated as to be automatically actuated upon the passage of a moving train by means of its impact or weight, or otherwise. At a point considerably nearer the station or junction—say about three thousand feet therefrom—is placed another similar circuit-breaker, K′, also adapted to be actuated by the moving train. At the entrance of the station-yard or block-signal section, and preferably in the vicinity of the last-named circuit-breaker, is placed a visual or semaphoric danger-signal, S, which is actuated or controlled by an electro-magnet, *s*. This signal apparatus may be of any convenient or suitable construction, the only condition necessary being that when the controlling or actuating electro-magnet *s* is vitalized by a closed circuit a safety-signal shall be indicated, but when the circuit through the electro-magnet is broken a danger-signal shall be indicated. I have shown in diagram a simple form of signal which will serve to illustrate the principle of operation, consisting of a semaphore-arm, *s′*, which is overbalanced by a weight, s^2, tending to throw the arm into a horizontal position indicating "danger," as shown in Fig. 3, but which is normally depressed, in consequence of the elevation of the weight s^2, by the attractive force of the electro-magnet *s*. whereby the arm *s′* is maintained in a vertical or nearly vertical position, denoting "safety," as shown in Figs. 1 and 2. At the exit of the station-yard or block-section is placed a track circuit-closer, K^2, which is adapted to temporarily close an electric circuit upon the passage of a train in the direction indicated by the arrow.

At the station or junction the movable switch-rails, by means of which the main track is placed in connection with either of the sidings or branches A′ and A^2, may be moved to and fro in the usual manner by means of a bridle-rod, *b*, which is itself moved longitudinally in one direction or the other by means of a hand-lever, B, or other well-known or equivalent device. A simple circuit-breaker, *c*, of any suitable construction, is attached to some movable portion of the switch or its actuating-lever B, so that when the switch-rails are moved in either direction, so as to interrupt the continuity of the main line, an electric circuit is broken for the purpose of actuating the danger-signal at the entrance of the yard, as hereinafter explained. In practice I prefer, instead of attaching the circuit-breaker directly to some movable portion of the switch, as herein shown, to attach the same to the lock or guard of the switch-lever, in a manner fully set forth in the patent of Stephen C. Hendrickson, No. 199,977, of February 5, 1878, to which reference is had. The particular mode of attachment is, however, immaterial, so far as the present invention is concerned, it being only necessary that the circuit-breaker shall serve to break the circuit in case the switch is not in a safe condition for the passage of a train through the station-yard. I also apply to some suitable movable portion of the switch an electro-magnetic locking device of any suitable construction—such, for example, as that shown and described in the patent of Oscar Gassett, No. 228,187, of June 1, 1880, to which reference is had. The principle of action of such locking device, omitting the details of its construction, is shown in the figures.

D is an electro-magnet, the armature-lever of which is pivoted at *d*, and provided with a retracting-spring, *d′*. On the end of the armature-lever is a projection, d^2, which, when the armature-lever is released, falls into a slot, b^2, formed in some movable portion of the switch apparatus, so that when the armature is in this position the switch will be securely locked until the projection d^2 is restored to its original position by the action of an electric current upon the electro-magnet D. The particular construction of this device is immaterial, so far as my invention is concerned, and it may be applied directly to some movable part of the switch, as shown in the figures; but, as in the case of the circuit-breaker, it is considered preferable in practice to attach it to the lock or guard of the switch, rather than to the switch itself.

M is an electro-magnet provided with two independent coils or helices, *m* and *m′*, either of which produces a like magnetic effect upon its core. The armature-lever m^2 of this magnet normally rests upon a contact-stop, *v*, and it also carries an insulated contact-spring, *v′*, which, when the armature m^2 falls away from the poles of its electro-magnet, is brought against a contact-stop, v^2. A second electro-magnet, N, provided in like manner with two independent coils or helices, *n* and *n′*, has its armature-lever n^2 arranged in a similar manner, normally resting upon a contact-stop, *w*, and carrying an insulated contact-spring, *w′*, which plays between two fixed contact-stops, w^3 and w^4, as hereinafter explained.

O is a vibrating or continuously-ringing electric bell of well-known construction, which may be placed upon the passenger-platform, or in any convenient position in or about the station, the office of which is to give notice of the approach of a train when the same reaches the most distant circuit-breaker K, as hereinafter explained. P is a similar vibrating or continuously-ringing electric bell, the office of which is to produce a continuous alarm so long as the signal S indicates danger, thus calling the attention of the station-master to the same. The bells O and P are actuated by a single local battery, L, common to both, which is brought into action by the electro-magnets M and N, in a manner hereinafter set forth.

When the apparatus is in its normal position, the main track being clear for the pas-

sage of a train through the station-yard, the course of the electric circuits may be traced as follows: the first or locking circuit, commencing at the positive pole of the main battery E; thence by the wires 1 and 2 to the track circuit-breaker K; thence by the wire 3 to the locking-magnet D of the switch, (if there are two or more switches in the main track, the circuit passes through their respective locking-magnets in succession;) thence by the wire 4 to the coil or helix *m* of the electro-magnet M; thence by the wire 5, armature-lever m^2, contact-stop *v*, and wire 6 to the point 7; thence returning by the wire 8 to the negative pole of the battery, E. Thus a constant electric current normally traverses the locking-magnet D of the switch or switches, and also the helix *m* of the electro-magnet M, which latter electro-magnet keeps its own circuit closed by holding the lever m^2 in contact with the contact-stop *v*. The second or signal circuit, which is preferably derived from the same main battery, E, may also be traced as follows: from the positive pole of the battery E by wires 1 and 9 to track circuit-breaker K′; thence by wire 10 to electro-magnet *s*, controlling the signal S; thence by wire 11 to circuit-breaker *c*, attached to the switch or switches B; thence by wire 12 to a manual circuit-breaker, Q, (which may be placed in the office of the switchman or station-master,) thence by wire 13 to the coil or helix *n* of electro-magnet N, thence by wire 14 to armature-lever n^2 and contact-stop *w*, thence by wire 15 to the point 7, thence returning to the negative pole of the battery by wire 8. The electro-magnet N, by its attractive force, also keeps its own circuit closed by the contact of its armature-lever n^2 with the contact-stop *w*. If, now, a train approaches the station or junction from the direction indicated by the arrows, it first acts upon the circuit-breaker K, and temporarily interrupts the first-described or locking circuit. This causes the electro-magnet M to release its armature m^2, which immediately falls off from the contact-stop *v*, and interrupts its own circuit at this point, which thereafter remains broken at said point, notwithstanding it may have been again closed at K. Thus it will be understood that even a momentary interruption of the closed circuit at the point K will cause it to thereafter remain open until it is closed again between the armature-lever m^2 and the stop *v*. The position of the apparatus during the time in which the locomotive or train is passing from the circuit-breaker K to the circuit-breaker K′ will be best understood by reference to Fig. 2, in which the locking-magnet D will be seen to have released its armature, thus allowing the projection d^2 to enter the slot b^2, securely locking the switch or switches, and preventing any of them from being displaced after the train has passed the point K. The falling off of the armature m^2 when the train reaches the circuit-breaker K not only breaks the circuit of its own electro-magnet M, but the insulated contact-spring *v*′, which is mounted upon it, touches the contact-stop v^2, and thus closes the circuit of the independent local battery L through the alarm-bell O, which thereupon rings continuously, announcing the approach of the train and notifying the station-master or switchman to immediately replace the switches, in case any of them are wrong. When the train in its progress reaches the second circuit-breaker, K′, situated at or near the entrance of the station-yard or block-section, the second or signal circuit is momentarily broken at that point, which releases the armature n^2 of the electro-magnet N, allowing the same to fall off and break its own circuit at the contact-stop *w*. The position of the apparatus after the locomotive or train has passed the second circuit-breaker, K′, and is traversing the station-yard or block-section, is illustrated in Fig. 3. The electro-magnet *s* has released its armature, thus causing the semaphore-arm *s*′ of the signal S to be extended in a horizontal position, indicating "danger." The actuating-lever B of the switch or switches still remains locked, as before. The armature-lever n^2 of the electro-magnet N has also been released, and the insulated contact-spring *w*′ has been lifted from the contact-stop w^4 and brought into contact with the stop w^3, the result of which is to transfer the current of the local battery L from the alarm-bell O to the other continuously-ringing bell, P, which latter continues to sound so long as the train is at the station, or anywhere within the limits of the station-yard or block-section, while the bell O, being required only to give warning of the approach of the train, is permitted to ring only while the train is passing from the circuit-breaker K to the circuit-breaker K′, after which it ceases and the other bell, P, commences to ring. After the train has passed a sufficient distance beyond the station—say three thousand feet—and arrived at the exit of the station-yard or block-section it momentarily actuates the circuit-closer K^2, (see Fig. 1,) the office of which is to restore all the apparatus to its normal position and to close the locking and signal circuits, which it does by momentarily closing a normally-open auxiliary circuit from the same battery, which may be traced as follows: from the negative pole of the battery E by wire 16; thence through circuit-closer K^2 and wire 17 to the coil or helix *n*′ of the electro-magnet N; thence by wire 18 to the coil or helix *m*′ of electro-magnet M, and thence by wires 19 and 1 to the positive pole of the battery. The closing of this circuit causes a current from the battery to traverse the auxiliary coils *m*′ and *n*′, and thereby causes both armatures m^2 and n^2 to be simultaneously attracted, and so soon as these are brought in contact with their respective contact-stops *v* and *w* the two circuits first described—that is to say, the locking and the signaling circuits—are re-established, and

thereafter hold themselves closed in the manner first described, so that although the circuit at K^2 be instantly broken again the armatures m^2 and n^2 will not fall off. The closing of the locking and signal circuits vitalizes the magnet D and unlocks the switches, and also vitalizes the magnet *s* and withdraws the danger-signal. In case the switch at the station is displaced, so as to interrupt the main track, the breaking of the circuit at *c* produces precisely the same effect as if it had been broken at K′ by the approaching train. The danger-signal is exhibited at S, and the continuously-ringing bell P in the office of the switchman or station-master is set in operation and continues to ring as long as the switch is displaced. The replacement of the switch, on the contrary, does not withdraw the danger-signal at S. This can only be done by momentarily closing a key, *k*, which completes the normally-open auxiliary circuit in the same manner as the circuit-closer K^2, which should be placed in the office of the switchman or station-master, and may, if necessary, be secured by a special lock, so that it cannot be operated by an unauthorized person.

The manual circuit-breaker Q also serves to independently break the same circuit and exhibit the danger-signal if, from any cause, the station-master or switchman wishes to signal an expected train and prevent it from entering the station-yard or block-section, or passing beyond the signal S.

In case it is desirable or necessary to unlock one or more switches within the station-yard or block without withdrawing the danger-signal at the entrance of the section or block—as, for example, in case a train which has arrived at the station, and is under the protection of the danger-signal, is to be placed on a side-track, instead of being allowed to proceed on its way—it is only necessary that the station-master or other authorized person should open the circuit-breaker Q, and at the same time depress the key *k*. The breaking of the signal-circuit at Q will retain the signal S at "danger," while the closing of the key *k* will transmit a current through the electro-magnet M, thus restoring the locking-circuit and unlocking the switch or switches.

It will be obvious that the accidental breakage of a conducting-wire or the failure of a battery will either cause the signal S to indicate "danger," or will prevent it from being placed in a position to indicate "safety," as the case may be.

In order to guard against an erroneous safety-signal being given by an accidental contact between the wires 16 and 17, a special signal, consisting, preferably, of a small alarm-bell, Z, may be placed in the circuit of one of these wires, as shown in Fig. 1, which, in case of such accidental contact, will keep up a continuous alarm, thereby immediately calling the attention of the station-master to the occurrence.

It is obvious that two or more electro-magnetic switch-locks and two or more circuit-breakers operated by switches may be included in their respective circuits, so that all the switches in the main line will be simultaneously locked upon the approach of the train, and the movement of any one of these switches will cause the danger-signal to be exhibited at the entrance of the yard or block-section.

The hereinbefore-described system of electric locking or unlocking of a switch-lever may be applied to any other hand-actuated lever employed for similar purposes, such as that of actuating an electric or non-electric safety-signal on the line of track over which the train is to pass, or for actuating a danger-signal, either mechanically or electrically, upon the line of an intersecting or crossing track, so that said danger-signal lever and its signal may be locked at "danger" by an approaching train acting upon the track circuit-closer K, and thus remain locked until the train shall have passed the point of intersection, and have actuated a circuit-breaker, K^2, for unlocking it.

It is obvious that the device is applicable to the locking and unlocking of any hand-actuated lever or other mechanism ordinarily used in connection with movable appliances—such as draw-bridges, signals, and the like—employed on or along railway-tracks, or any one or more of a series of levers, such as are used in the so-called "interlocking" apparatus of Saxby and Farmer, or other like systems.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of a main battery, a normally-closed main or locking circuit, an electro-magnet, armature and armature-lever, a circuit-closer actuated by said armature-lever only when in proximity to the poles of said electro-magnet, whereby said main circuit is completed through the coils of said electro-magnet, an independent electro-magnet also included in said main circuit, and a locking device which is brought into action by the demagnetization of said electro-magnet upon the breaking of the main circuit, for preventing the displacement of a switch while said circuit remains broken.

2. The combination, substantially as hereinbefore set forth, of a normally-closed main or locking electric circuit, a circuit-breaker situated at the entrance of a determinate section of railway-track, a switch situated within said section of railway-track, a locking device for preventing the displacement of said switch, and an electro-magnet included in said electric circuit, which causes said device to lock the switch upon the release of its armature when said electric circuit is interrupted, and to unlock the same when the circuit is restored, and a circuit-closer and connections, substantially as described, actuated from a point at or near the exit of said section of railway-track, and adapted to re-establish said

circuit when actuated by a receding train, whereby said switch will remain locked during the time in which the train is traversing said section.

3. The combination, substantially as hereinbefore set forth, of a main battery, a normally-closed main or locking circuit, an electro-magnet, armature and armature-lever, a circuit-closer actuated by said armature-lever only when in proximity to the poles of said electro-magnet, whereby said main circuit is completed through its coils, a circuit-breaker actuated by a moving train at another point in the same circuit, an independent electro-magnet included in said circuit, a locking device which is brought into action by the demagnetization of the last-named electro-magnet, to prevent the displacement of a switch while said circuit is broken, and an additional magnetizing-helix, auxiliary circuit, and circuit-closer actuated by a moving train, whereby the first-named circuit remains broken and the switch locked until said circuit is again closed by the action of the auxiliary circuit and track circuit-closer.

4. The combination, substantially as hereinbefore set forth, of a main battery, a normally-closed main or locking circuit, an electro magnet, armature and armature-lever, a circuit-closer actuated by said armature-lever only when in proximity to the poles of said electro-magnet, whereby said circuit is completed through its coils, an independent electro-magnet included in said circuit, a locking device which is brought into action by the demagnetization of the last-named electro-magnet, to prevent the displacement of a switch while said circuit is broken, and an additional magnetizing-helix, auxiliary circuit, and hand circuit-closer, whereby the first-named circuit remains broken, and the switch locked until said circuit is again closed by the completion of the auxiliary circuit by means of said hand circuit-closer.

5. The combination, substantially as hereinbefore set forth, of a main battery, a normally-closed main or locking circuit, an electro-magnet, armature and armature-lever, a circuit-closer actuated by said armature-lever only when in proximity to the poles of said electro-magnet, whereby said main circuit is completed through its coils, a circuit-breaker for breaking said normally-closed main circuit, which is actuated by a moving train, an independent electro-magnet included in said circuit, a locking device which is brought into action by the demagnetization of the last-named electro-magnet, to prevent the displacement of a switch while the main circuit is broken, and an additional magnetizing-helix, auxiliary circuit, and hand circuit-closer, whereby the first-named circuit remains broken and the switch locked until said circuit is again closed by the completion of the auxiliary circuit by said circuit-closer.

6. The combination, substantially as hereinbefore set forth, of a main battery, a normally-closed main or locking circuit, an electro-magnet, armature and armature-lever, a circuit-closer actuated by said armature-lever only when in proximity to the poles of said electro-magnet, whereby said main circuit is completed through its coils, a circuit-breaker for breaking said normally-closed main circuit, which is actuated by a moving train, an independent electro-magnet included in said circuit, a locking device which is brought into action by the demagnetization of the last-named electro-magnet, to prevent the displacement of a switch while the main circuit is broken, an additional magnetizing-helix, and a normally-open auxiliary circuit provided with two circuit-closers, one actuated by hand and the other by a moving train, whereby the first-named circuit remains broken and the switch locked until said circuit is again closed by the completion of the auxiliary circuit through one or the other of said circuit-closers.

7. The combination, substantially as hereinbefore set forth, with a section of railway of determinate length, of a normally-closed locking-circuit, an electro-magnet included in a normally-open auxiliary circuit, and a circuit-closer actuated by the armature of said electro-magnet, whereby the locking-circuit may be restored after having been broken for the purpose of actuating the locking devices.

8. The combination, substantially as hereinbefore set forth, with a section of railway of determinate length, of a normally-closed locking-circuit, a normally-closed signal-circuit, one or more electro-magnets included in a normally-open auxiliary circuit, and a circuit-closer actuated by the armature of said electro-magnets, whereby both the locking and the signal circuit may be closed by closing the auxiliary circuit after having been broken for the purpose of actuating the locking device and signaling apparatus.

9. The combination, substantially as hereinbefore set forth, of a normally-closed locking-circuit, a normally-open auxiliary circuit, an electro-magnet included in said circuit for actuating a circuit-closer in the locking-circuit, and an alarm whereby the accidental closing of the auxiliary circuit will be indicated.

In testimony whereof I have hereunto subscribed my name this 1st day of September, A. D. 1883.

FRANK L. POPE.

Witnesses:
DANIEL W. EDGECOMB,
CHARLES A. TERRY.