(No Model.) 3 Sheets—Sheet 1.

M. B. LEONARD.

ELECTRIC SIGNALING APPARATUS AND SYSTEM.

No. 560,619. Patented May 19, 1896.

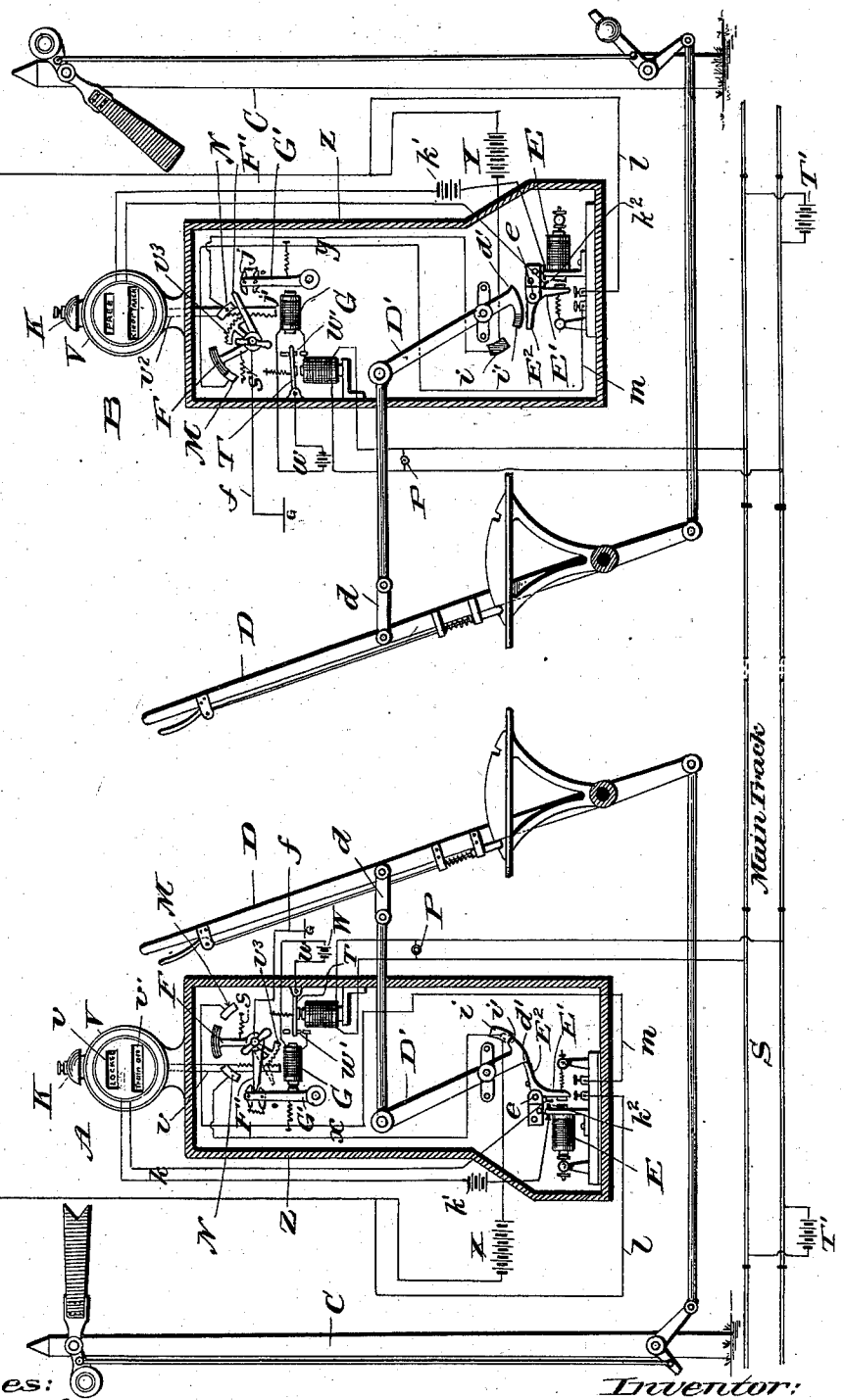

Fig. 1.

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Inventor:
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his Atty.

(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

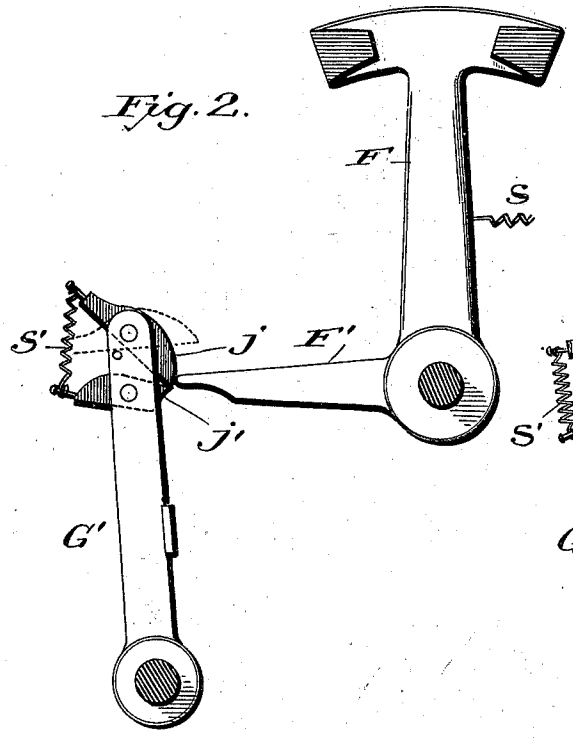


Fig. 3.

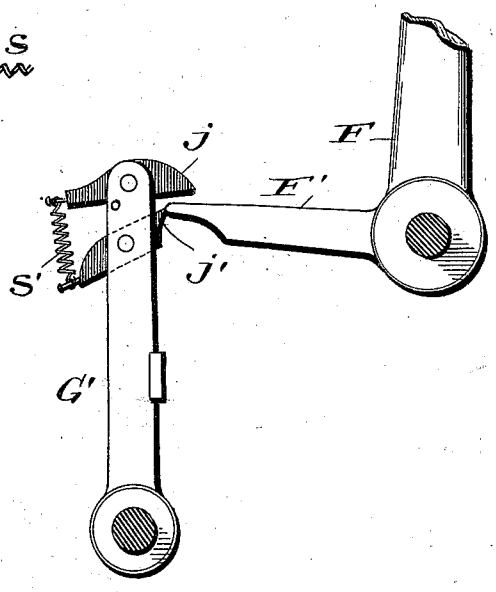


Fig. 4.

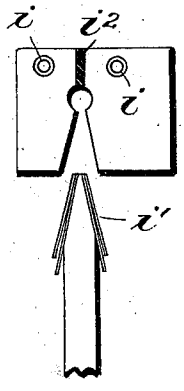
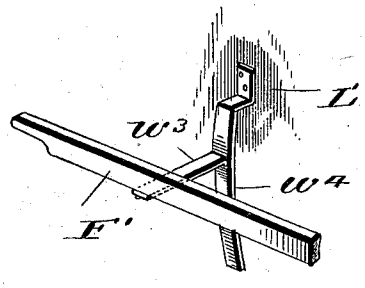


Fig. 6.



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(No Model.) 3 Sheets—Sheet 3.

M. B. LEONARD.

ELECTRIC SIGNALING APPARATUS AND SYSTEM.

No. 560,619. Patented May 19, 1896.

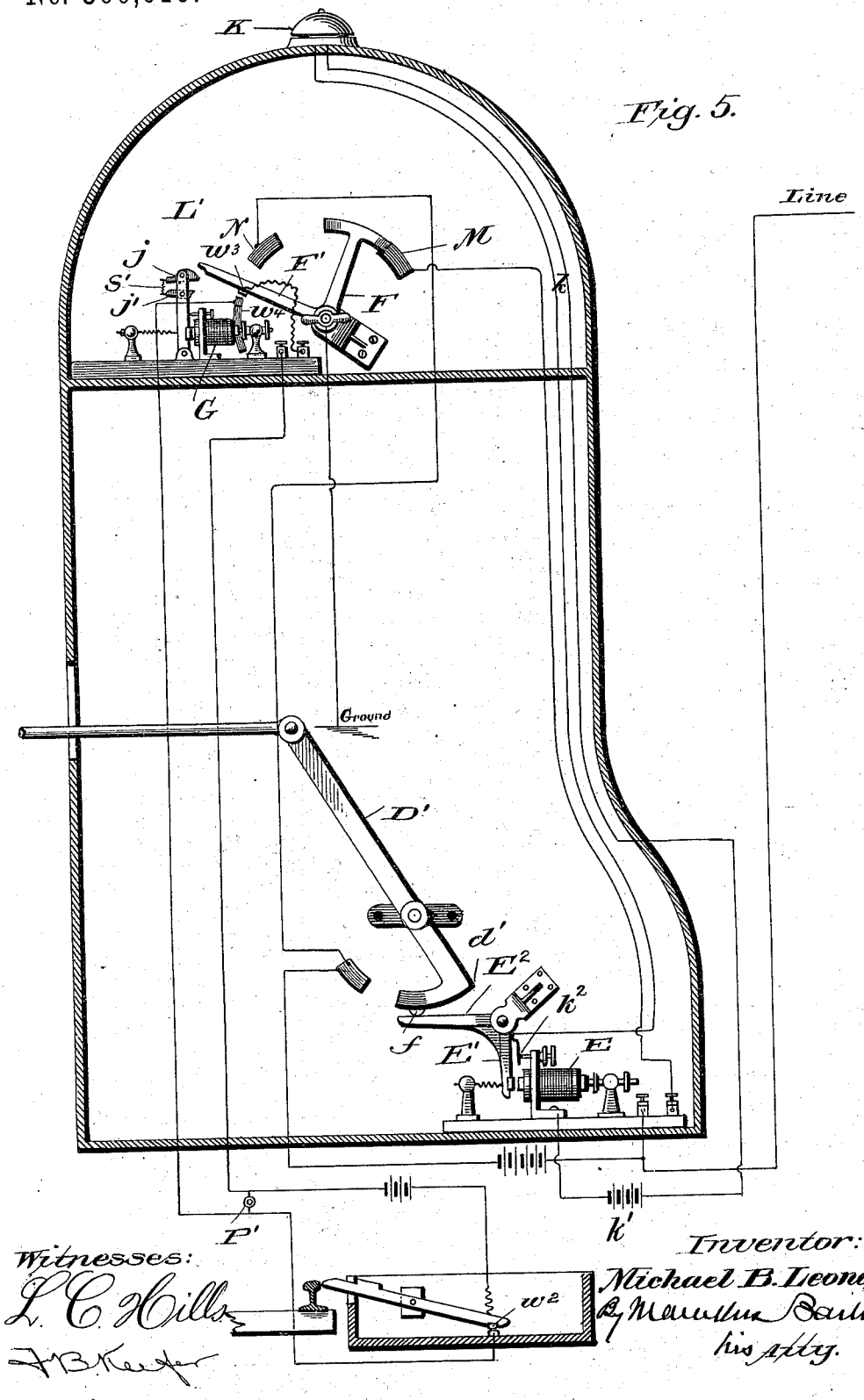

Fig. 5.

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UNITED STATES PATENT OFFICE.

MICHAEL BARRY LEONARD, OF RICHMOND, VIRGINIA, ASSIGNOR TO THE ELECTRIC SELECTOR AND SIGNAL COMPANY, OF WEST VIRGINIA.

ELECTRIC SIGNALING APPARATUS AND SYSTEM.

SPECIFICATION forming part of Letters Patent No. 560,619, dated May 19, 1896.

Application filed November 10, 1894. Serial No. 528,382. (No model.)

To all whom it may concern:

Be it known that I, MICHAEL BARRY LEONARD, a citizen of the United States, residing at Richmond, in the State of Virginia, have invented certain new and useful Improvements in Electric Signaling Apparatus and Systems, of which the following is a specification.

My invention has been designed with particular reference to the needs of railway block-signaling systems, and it is in this connection that I shall describe it. In a recent patent, No. 517,419, granted to me on March 27, 1894, I have described and claimed a block-signaling system comprising a ground-switch at each station controlling two contacts included the one in a circuit also including an unlocking-magnet at the home station (*i. e.*, the same station with the switch) and an energizing-battery at the distant station and the other in a circuit including an energizing-battery at the home and an unlocking-magnet at the distant station, the switch normally resting against the first-named contact, and the arrangement being such that each battery, by its home ground-switch, will be thrown into circuit with the unlocking-magnet at the distant station without affecting the unlocking-magnet at the home station, a further condition being that the circuit cannot be closed until after the home signal is placed in normal position. This system, while efficient so far as it goes, is defective in that no way has been provided of preventing the operator at the home station from releasing the signal at the distant station a number of times in succession before the block is cleared or of preventing the operator at the distant station from releasing the signal at the home station should the home station forget about the train on the block and ask for the release of his signal.

The object of one part of my improvements is to prevent any such occurrence. To this end I superadd to the system above referred to means whereby, after the ground-switch at the home station has been moved to close the circuit from the home battery through the unlocking-magnet at the distant station, said switch when released, instead of returning to normal position, shall be automatically locked and held in an intermediate neutral position out of contact with either one of its contact-plates, thus interrupting both of the circuits hereinbefore referred to and rendering it impossible for either of the two stations to unlock the signal of the other, this condition of things continuing until the train on the block reaches a predetermined point, where it meets mechanism to be operated by it, whereby the locked ground-switch is released and allowed to return to normal. After one station has released the signal of the other it consequently is impossible for this operation to be repeated from either station until after the train on the block has met and operated on the releasing mechanism for the locked ground-switch.

Another portion of my invention has relation to a provision whereby the home station cannot release the signal at the distant station until the home signal is in normal position, this provision consisting in placing in the circuit connections between the home battery and the unlocking-magnet at the distant station contacts which are closed only when the home-signal lever is at normal; but this, together with the other features of my invention, can best be explained and understood by reference to the accompanying drawings. I shall first describe in detail the apparatus and system therein represented and will then point out those features therein which I believe to be new and of my own invention.

In the drawings, Figure 1 is a view, mainly diagrammatic, of two intercommunicating railway block-stations equipped in accordance with my invention. In this figure the ground-switch at station B is in its normal position. The like switch at station A is locked in the intermediate neutral position which it assumes when, after having made the contact through which the releasing-circuit of the signal-operating lever at station B is completed, it is permitted to return toward its normal position. Fig. 2 is a view of the upper end of the switch-locking armature, together with a part of the switch, showing the position of parts when the detent-arm of the switch is passing the hinged locking-jaws of the armature during the movement of the switch to close the circuit of the signal-

lever-releasing magnet at the other station. Fig. 3 is a like view of the same, showing the position assumed by the parts when the detent-arm is returning after said circuit has been closed. Fig. 4 is a plan of contacts shown in side elevation in Fig. 1. Fig. 5 is a side elevation, partly in section, of a modified form of the apparatus, which will hereinafter be more particularly referred to. Fig. 6 is a perspective view of the detent-arm of the ground-switch in Fig. 5, together with the contacts which it controls.

The apparatuses at both stations are the same, so that a description of one will answer for both.

The apparatus is contained in a box Z, which usually is located on a low stand in front of the levers at the station. The signal to be operated (which may be of any desired kind) is typified by the conventional counterweighted semaphore C, connected by any suitable system of bell-cranks and rods to a signal-operating lever D, having joined to it by a link or connecting-rod d the pivoted vibratory locking-bar D′. E is the releasing-magnet having a bell-crank armature-lever E′ E² pivoted at e in a suitable supporting yoke or bracket. The lower and vertical limb E′ of the lever carries the armature and has the usual retractile spring. The upper and horizontal limb E² of the lever is a stop to engage the heel d' of the pivoted locking-bar D′. When the locking-bar is in normal position, which is that shown at station A, Fig. 1, (the position it occupies when its signal-lever is at "danger,") its heel d' abuts against the end of the horizontal limb E² of the armature-lever. When the releasing-magnet E is energized and attracts its armature, the limb E² moves down and out of the path of the locking-bar D′, thus permitting the latter to move freely to the position shown at station B, Fig. 1. In returning to normal the heel of the locking-bar rides over and depresses the limb E², and the latter by the armature retractile spring is at once returned to locking position as soon as the heel of the bar passes beyond and clears it. The bell-crank form of armature-lever, as shown, is advantageous in that the lever may be quite balanced, so as to require but very little retractile-spring power to operate it. Indeed, by putting somewhat more weight in its vertical limb than in the other, the latter, by gravity, will always tend to rise into locking position. The lever is thus made quite sensitive, and consequently but comparatively little battery-power will be required for the releasing-magnet. The use of a pivoted vibratory locking-bar permits me, when I so desire, to dispense with the usual signal-operating lever, and to use in lieu thereof a rope or hand-pull, which can be directly connected to the bar. In this event the bar would have connections to the semaphore similar to those which the signal-operating lever now has.

F is the pivoted ground-switch having a ground connection f. It is adapted to play between two contact-plates M N. A spring s draws it over against and into electrical connection with the contact M, and this is its normal position of rest. At each station there is a local battery, (lettered, respectively, X for station A and Y for station B.) Between the two stations extends the line-wire L, having one of its terminals connected to one pole of X battery and its other terminal connected to one pole of Y battery. The opposite pole of X battery is connected by wire x to contact-plate N at A station. The opposite pole of Y battery is connected by wire y to contact-plate N at B station. The terminals of the releasing-magnet E at each station are connected, respectively, to the contact-plate M at that station by wire m' and to line L by wire l. Normally the semaphores are at "danger," and the signal-levers are locked in that position. Provision (which I have deemed it unnecessary to represent) is of course made for telegraphic communication between the two stations, so that the operator at either may communicate with the other. Let it be supposed that a train is approaching B station and that the operator there is desirous of setting his signal to "safety." He telegraphs to that effect to A station, and the operator there turns his ground-switch so as to make contact at N. The circuit then will be from ground through A's ground-switch and contact-plate N, wire x, battery X, line L to station B, wire l, releasing-magnet E, wire m, contact M, and thence through B's ground-switch to ground. The result will be to energize the releasing-magnet E at B station, thus moving its bell-crank armature-lever in a direction to release the locking-bar D, consequently allowing the B operator to throw his signal-lever and set his semaphore at "safety," in which last-named position the B signal-lever and semaphore are shown in Fig. 1. After the release of B's signal-lever the operator at A allows his ground-switch to return to normal position.

In the system thus far described there is nothing to keep the operator at A from closing the circuit of the releasing-magnet E at B station a number of times, the disadvantages of which I have hereinbefore adverted to. To prevent such occurrence, I superimpose on the system devices whereby the switch in returning from N to M is automatically locked in neutral position out of electrical connection with either contact-plate and is compelled to so remain until the train for which B's signal was set at "safety" has reached a predetermined point where it will meet and operate means whereby the switch is released from control of its lock and allowed to return to normal position. To this end the ground-switch F is formed or provided with a radial arm F′, which may be termed a "detent-arm," this arm swinging with the switch. In the path of movement of the detent-arm is a pivoted armature-lever G′—the switch-locking

armature—provided with the usual retractile spring and influenced against the stress of its spring by the electromagnet G—the locking-magnet—included in a normally-closed circuit w, embracing a battery W and completed through contacts w', controlled by the track-relay T. This relay is in a normally-closed track-circuit embracing a track-battery T' and completed through the rails of an insulated track-section S. By the locking-magnet the locking-armature is held normally in locking position. The free end of the armature-lever is armed on that face of it which is met by the detent-arm with two movable, and in this instance pivoted, dogs or jaws $j\,j'$, with space enough between them to receive the end of the detent-arm. The two jaws are held projected and substantially parallel with each other by one or more springs s', and this is their normal position. From this position the top jaw j can swing down, but not up, and the bottom jaw can swing up, but not down. In other words, they can close inwardly or toward each other; but they cannot move outwardly and away from each other beyond their normal position. The top jaw j is so shaped and proportioned that when wiped against and consequently depressed by the detent-arm it will fill the space between it and the bottom jaw and will furnish a path by which the end of the detent-arm in its descent can clear and pass below the bottom jaw, as indicated in Fig. 2. The bottom jaw j' is so shaped and is of such length that the detent-arm on its return can wipe by and clear it by the time it reaches the upper jaw, as indicated in Fig. 3, thus allowing the bottom jaw to open and to project below under the end of the detent-arm, which consequently will then be held between the two jaws and will be incapable of movement until the locking-armature is pulled back far enough to take the jaws out of the path of movement of the arm.

The operation is as follows: When the ground-switch—*e. g.*, that at station A—is thrown over to contact with N, and consequently to close the circuit at that point between X battery and the signal-releasing magnet at B station, the detent-arm of the switch in this movement meets and forces back the locking-armature, wiping past its jaws $j\,j'$, as indicated in Fig. 2, and, finally, by the time the switch meets contact N, passing below the bottom jaw j', as indicated by dotted lines at A station in Fig. 1, at which time the locking-armature, being released from the backward push of the detent-arm, is again pulled forward by its magnet, as indicated in the same figure. Now when the switch is released and permitted to return toward its normal position its detent-arm will close up and wipe by the bottom jaw j', as indicated in Fig. 3, until it meets and is arrested by the upper jaw j, by which time it will have cleared the lower jaw j'. The latter by its spring is at once returned to normal position, and the detent-arm, as shown by full lines at station A in Fig. 1, is thus held between the jaws of the locking-armature incapable of farther movement in either direction and in a position in which the switch itself is out of contact with both of the contact-plates M N. This condition of affairs continues until the train on the block between the two stations reaches the track-section S, adjoining A station, whereupon the track-circuit is completed through the path of comparatively low resistance afforded by the wheels and axles of the train. The track-relay consequently is cut out or deënergized, thus opening the locking-magnet circuit, and the locking-armature, being now free from the influence of its magnet, is by its retractile spring drawn back far enough to cause its jaws to clear the detent-arms, consequently releasing the switch, which returns to normal position. Then and only then can the switch be again manipulated by the operator.

In the arrangement just described the locking-magnet is in a normally-closed circuit and operates to draw the locking-armature into locking position against the stress of its retractile spring, but obviously the arrangement can be reversed. The locking-armature can be held in locking position by its spring, and the locking-magnet can be used to draw the armature into releasing position, for which purpose it would be included in a circuit, including normally open contacts controlled by the track-relay. This would be a mere reversal of the arrangement already described, obvious to any one skilled in the art and requiring, therefore, no illustration.

It is also obvious that in the employment of a track-relay or normally-closed circuit, as contemplated in the arrangement illustrated in the drawings, the circuit can be independent of the track-rails and may contain normally-closed contacts, which by a treadle or other known instrumentality located at the desired point and adapted to be operated by the passing train can be opened to break the track-circuit and consequently deënergize the track-relay. So, too, the track-relay might be dispensed with and the locking-magnet might be directly included in the track-circuit, thus doing away with the circuit w and its battery W. In this case the armature-lever could be held in locking position by its retractile spring, and its magnet G (which in this instance would act not to lock but to release) in that event would be in a circuit completed through normally open contacts controlling a track-treadle, which when struck by a passing train would close said contacts, thus completing the energizing-circuit of magnet G and causing the latter to attract its armature, with the result of releasing the ground-switch.

Still another circuit arrangement, which is not so obvious as those above referred to and which I therefore illustrate, is shown in Fig.

5. In this figure the magnet G acts as a locking-magnet. Its energizing-circuit w contains two sets of contacts w^2 and w^3 w^4. The former w^2 are normally closed and are controlled by a track-treadle, which when struck by a passing train will open them. The latter w^3 w^4 are normally open and are closed only when the ground-switch has quitted its normal contact M and has been moved toward the other contact N. The contact w^3, which is carried by the detent-arm F′, projects laterally and horizontally therefrom toward the rear of the case L, as shown in Fig. 6, so that it may meet the stationary contact w^4, which, as shown in the same figure, is attached to the rear wall of the case and is a spring-strip of some length, its size and location being such that immediately after the ground-switch quits M and before the detent-arm reaches the locking-armature its contact w^3 will have met contact w^4, thus completing the locking-circuit and drawing forward the armature (which up to this time has been retracted by its spring) into locking position. The strip w^4 is of such length that it is still in contact with its fellow contact w^3 after the switch has been moved to its N position. In other words, the locking-circuit is completed at w^3 w^4 whenever and so long as the switch is away from its M position. In this way the locking-circuit is always open except when the operator has moved his ground-switch from normal. This closes the circuit and it remains closed until the passing train operates the treadle to open it at w^2. Then the ground-switch is released and the normal circuit conditions of the locking-circuit are restored. It may be that at times some exigency will arise to require the semaphore at B to be again released before the train on the block reaches A, and therefore in the arrangement shown in Fig. 1 I provide at a point in the track-circuit convenient to the operator at A a push-button or the like P and cross or shunt connections, whereby the track-magnet will be cut out or short-circuited, with the result of releasing the ground-switch. There is a like push-button in the track-circuit at B station. It is to be noted that this push button or key can be placed in the circuit w of the locking-magnet instead of in the track-circuit, what is aimed at being to provide manually-operated means for changing, when desired, the circuit conditions in such manner as to deënergize the locking-magnet. Analogously and for the same purpose I can provide in the circuit of the locking-magnet in Fig. 5 a manually-operated key P′ for breaking or opening that circuit. It may happen that the operator at one station—*e. g.*, station A—will call on the operator at station B to release his (A's) signal while B's signal is still at "safety," and that B, unmindful of this fact, will release A's signal. To prevent any such occurrence I place in the circuit of each battery X and Y a pair of contacts i, which by a contact-toe i' on some appropriate part of the signal-operating mechanism—in this instance the vibratory locking-bar D′—are closed only when the signal-operating lever is in normal or "danger" position. Thus so long as the signal-lever at B is in "safety" position, as shown, it is not possible for the B operator to release the A signal. To do this he must first return his signal to "danger." The contacts i (shown in plan in Fig. 4) are two plates of conducting material electrically separated from one another by insulating material i^2 and having between them a V-shaped opening adapted to be entered by the similarly-shaped movable contact-toe i'.

To complete the description of the apparatus, it remains to refer to the indicator. This comprises an annunciator-bell K of ordinary type in a local circuit k, with battery k', and completed through normally open contacts k^2, which are closed only when the signal-lever at the station with the annunciator is released, for which purpose the contacts are in the present instance closed by the armature-lever E′ E² when the latter is attracted, one of said contacts being carried by the lever. In this way the operator is notified that his signal-lever is unlocked. In addition to the annunciator is a visual indicator V. In the case of this indicator are two openings, in the upper one, v, of which appears one or the other of the words "Free" and "Locked," according to the condition of the signal-lever. In the lower opening v' appears one or the other of the legends "Train on" and "Clear track," according to the condition of the block. The upper words "Free" and "Locked" are on a device operated to move by electromagnetic instrumentalities included in the bell-circuit k. The lower legends "Train on" and "Clear track" are on a device attached to and moving with a vertical rack v^2, supported to move up and down in suitable guides and gearing with a toothed segment v^3 on the hub or axle of the ground-switch. A more detailed description of these devices is not required, for they are well known to those acquainted with railway-signal systems.

In the arrangement shown in Fig. 1 the bell gives but a short ring, because so soon as the heel of the locking-bar has cleared the bell-crank armature-lever in the operation of throwing the signal to "safety" the lever is free to move (assuming the ground-switch at the other station to be on its return movement) to the position shown at B station, thus opening the contacts k^2. It is desirable, however, that so long as B's signal-lever is at "safety" the bell should continue to ring, so that the B operator may not forget the condition of his signal. To this end I can shape or form the heel of the locking-bar D′ as shown in Fig. 5, where it is provided with a wiper-cam or protuberance f, by which the bell-crank signal-locking lever will, after the locking-bar has been full-thrown, still be held in position to maintain the contacts k^2 of the

bell-circuit closed. Thus the bell will ring until the locking-bar has been returned to normal.

Having described the improvements and the best way now known to me of carrying the same into practical effect, what I claim herein as new and of my own invention is as follows:

1. In a block-signaling system substantially such as described, the combination with the ground-switch, and its two contact-plates, of locking mechanism by which said switch after having been moved from that plate with which it is normally in contact, to the other plate, is when returning to normal, automatically arrested and locked in neutral position out of contact with either plate, and means called into operation by a passing train whereby said switch is released from control of said locking mechanism, substantially as and for the purposes hereinbefore set forth.

2. The combination with the ground-switch, its detent-arm, and the locking-armature therefor, of the locking-magnet for influencing said armature and an electric circuit including said magnet and completed through two sets of contacts, the one normally closed and controlled by a track-treadle or train-operated device, the other normally open and controlled by the ground-switch, substantially as and for the purposes hereinbefore set forth.

3. The combination of the ground-switch and its contact-plates; the locking-armature for automatically engaging and locking the switch in neutral position during its return movement to normal; the locking-magnet for influencing said armature; an electric circuit including said magnet and completed through contacts closed at the time the ground-switch is in neutral position; and manually-operated means for changing the circuit conditions so as to deënergize the locking-magnet and thus release the ground-switch, substantially as and for the purposes hereinbefore set forth.

4. The combination with the ground-switch provided with a detent-arm, and the two contact-plates, with one of which the switch normally is in contact, of the locking-magnet and its armature-lever provided with hinged and spring-pressed locking dogs or jaws arranged, substantially as described, to permit the passage of the detent-arm when the switch is moved toward the other contact-plate, but to automatically engage and lock said arm after the switch, on its return movement to normal, has quitted the one contact-plate and before it has reached the other, substantially as and for the purposes hereinbefore set forth.

5. In an electric block-signaling system two connected stations, each provided with a ground-switch and two contact-plates; in combination with signal-operating mechanism at each station; locking mechanism for each signal-operating mechanism; a releasing-magnet therefor included in an electric circuit completed through contacts controlled by the ground-switch at the other station; a second set of contacts interposed in the same circuit and controlled by the signal-operating mechanism at said station in such manner as to be closed only when said signal-operating mechanism is in normal position; switch-locking mechanism whereby the ground-switch at said station, after having been moved from normal to its opposite position is when returning to normal automatically arrested and locked in neutral position out of electrical connection with either of its contacts; and means called into operation by a passing train whereby said switch is released from control of said locking mechanism, substantially as hereinbefore set forth.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

MICHAEL BARRY LEONARD.

Witnesses:
J. M. POWERS,
W. W. TALLEY.