(No Model.)

7 Sheets—Sheet 1.

J. P. COLEMAN.
SIGNALING SYSTEM.

No. 539,354. Patented May 14, 1895.

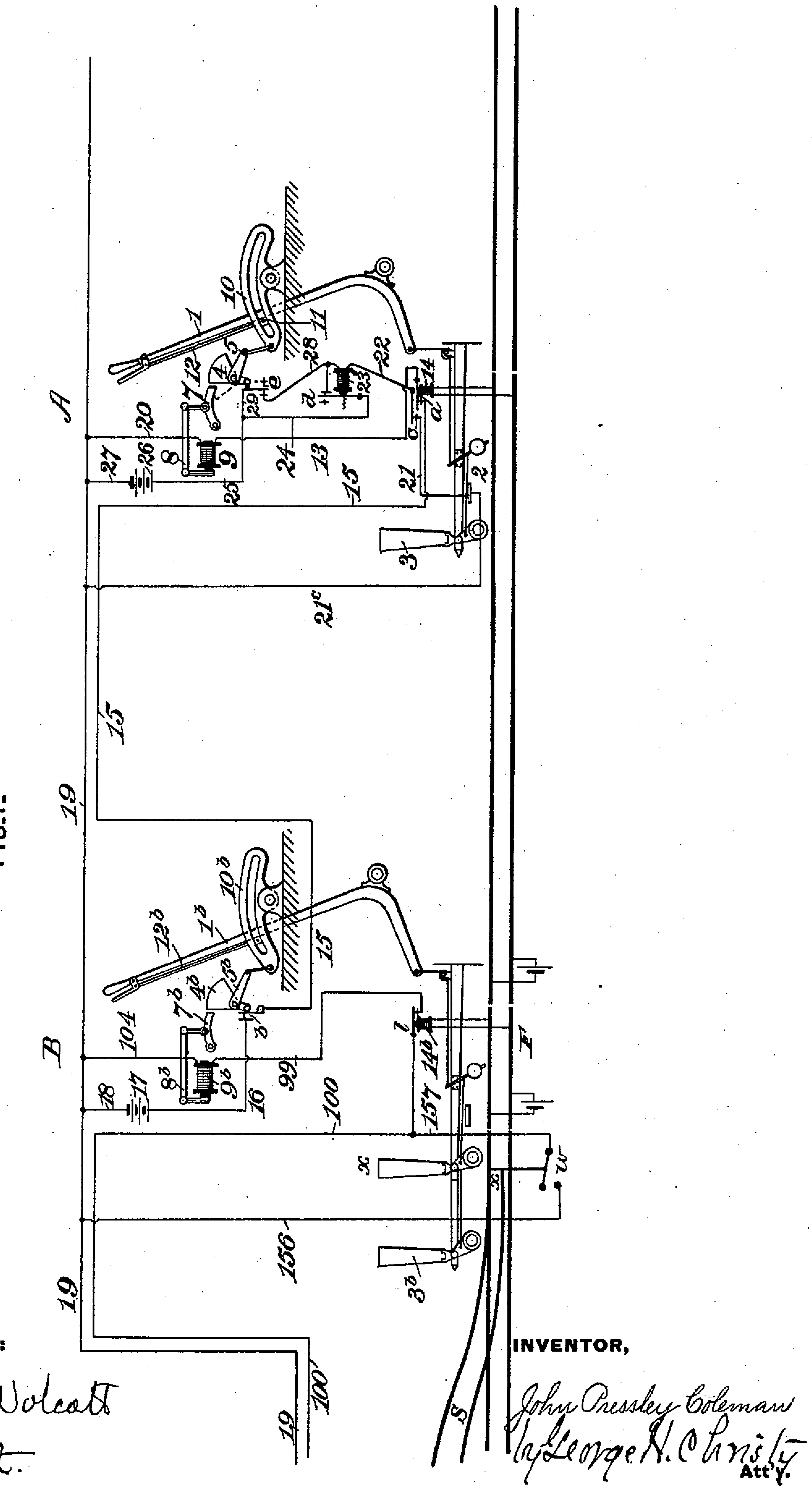

FIG. 1.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

7 Sheets—Sheet 2.

J. P. COLEMAN.

SIGNALING SYSTEM.

No. 539,354. Patented May 14, 1895.

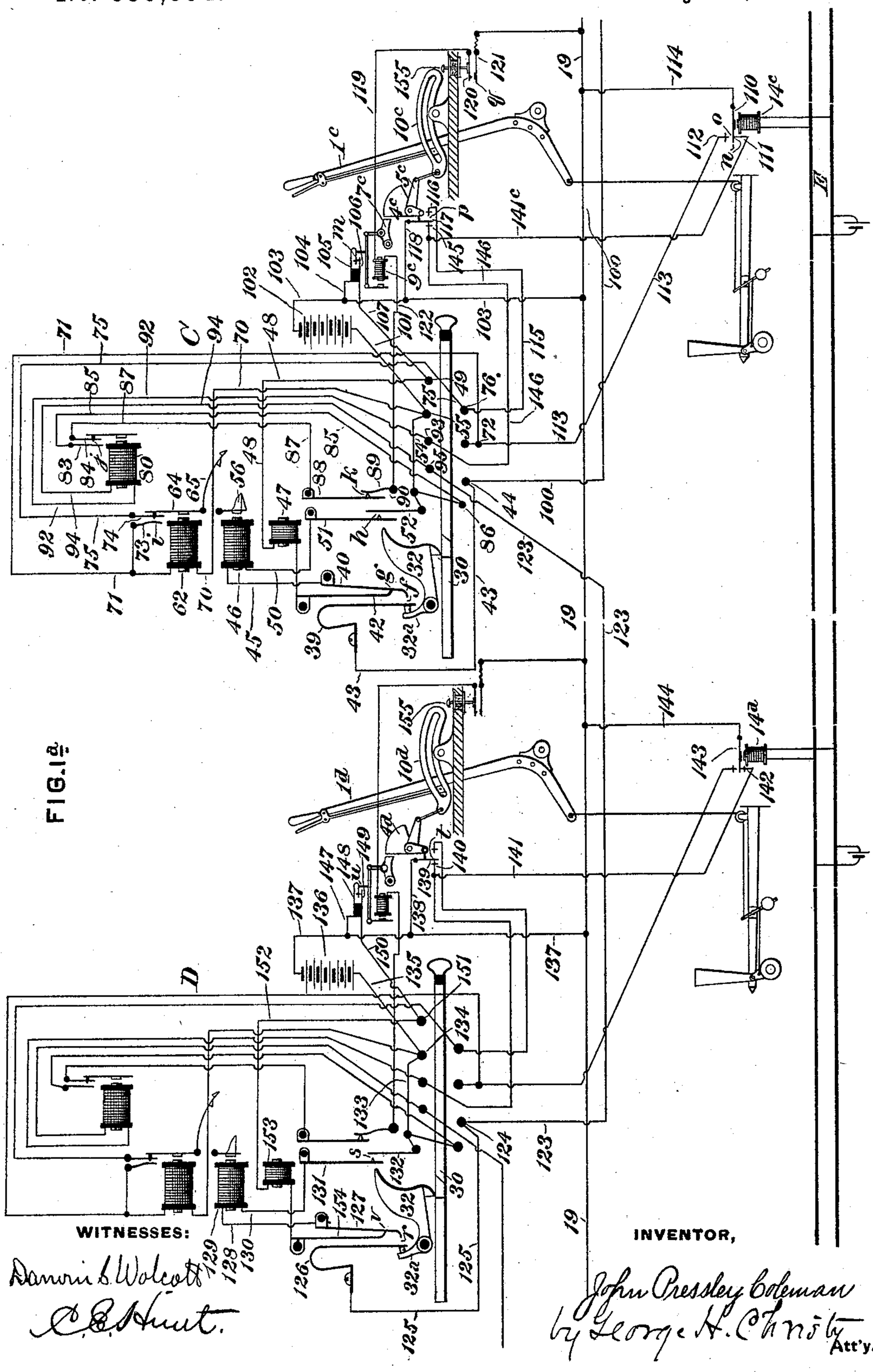

FIG. 1a.

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(No Model.) 7 Sheets—Sheet 3.

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SIGNALING SYSTEM.

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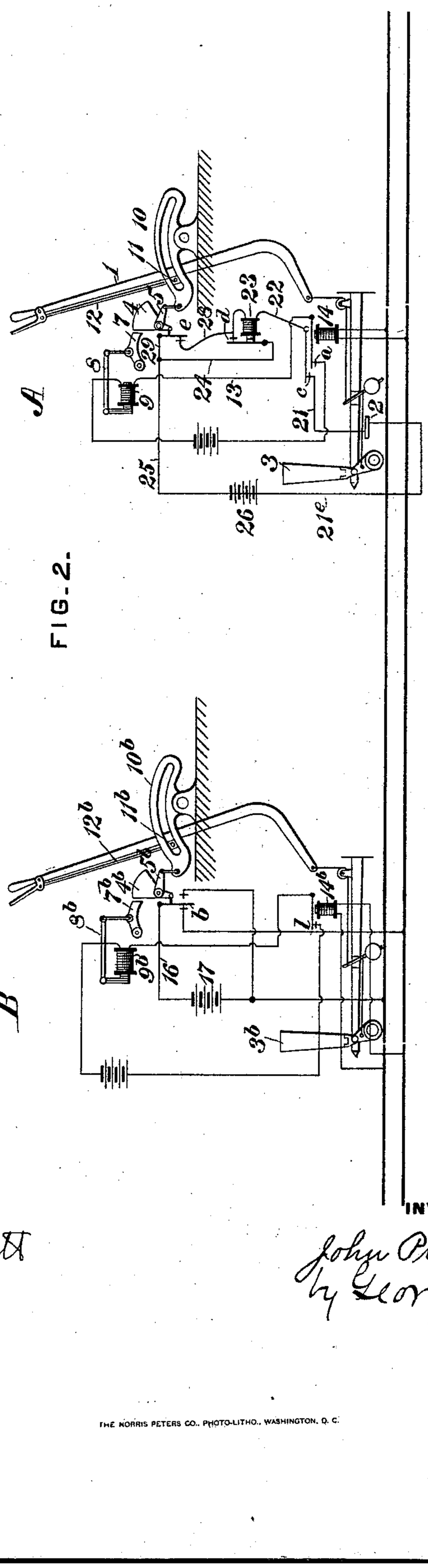

FIG. 2.

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7 Sheets—Sheet 4.

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SIGNALING SYSTEM.

No. 539,354. Patented May 14, 1895.

FIG. 3.

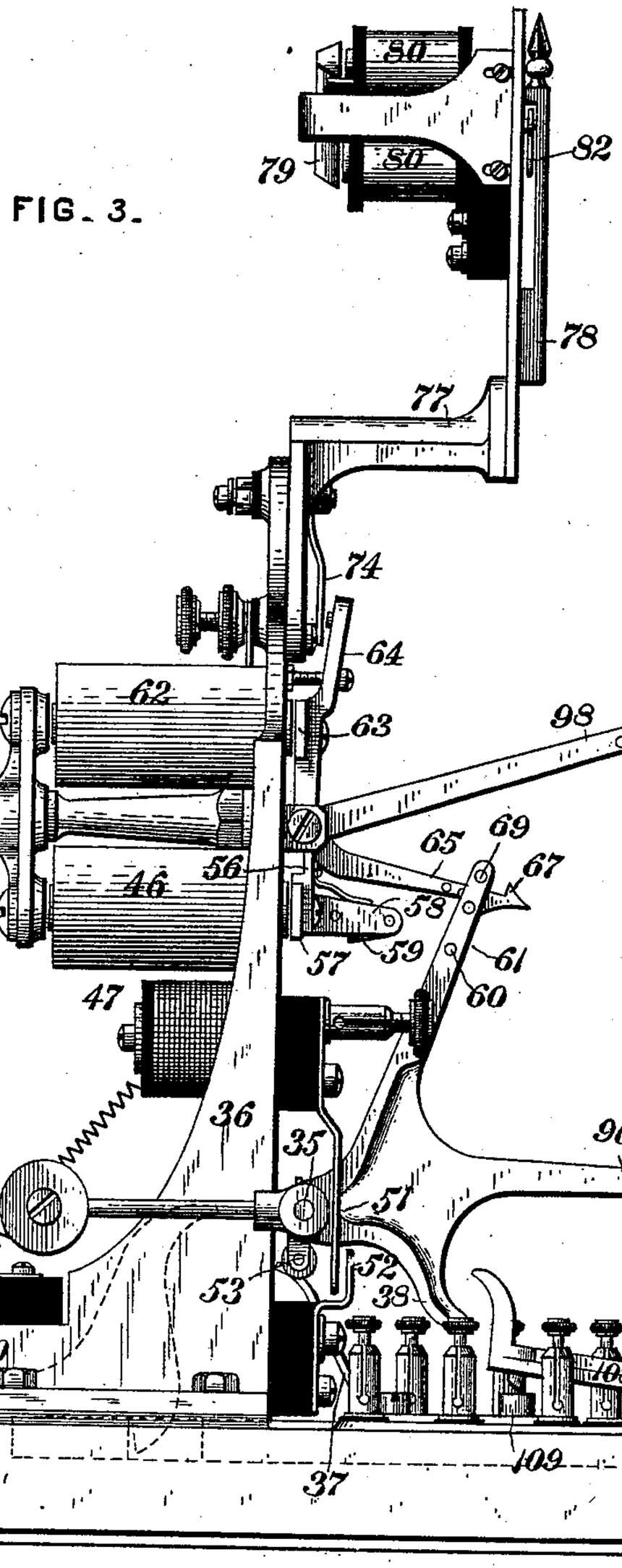
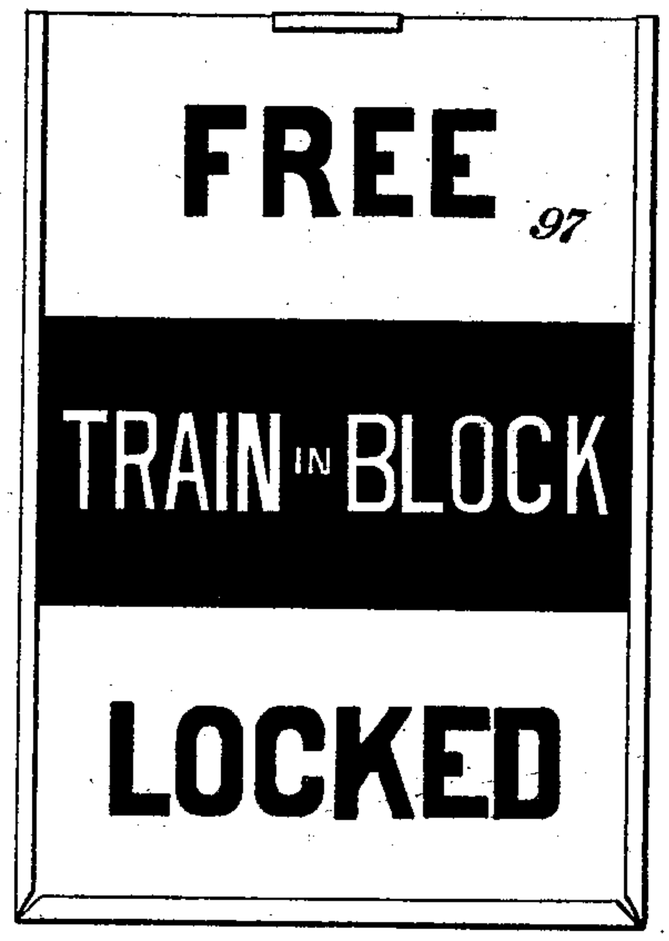


FIG. 8.



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(No Model.) 7 Sheets—Sheet 5.

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SIGNALING SYSTEM.

No. 539,354. Patented May 14, 1895.

FIG. 4.

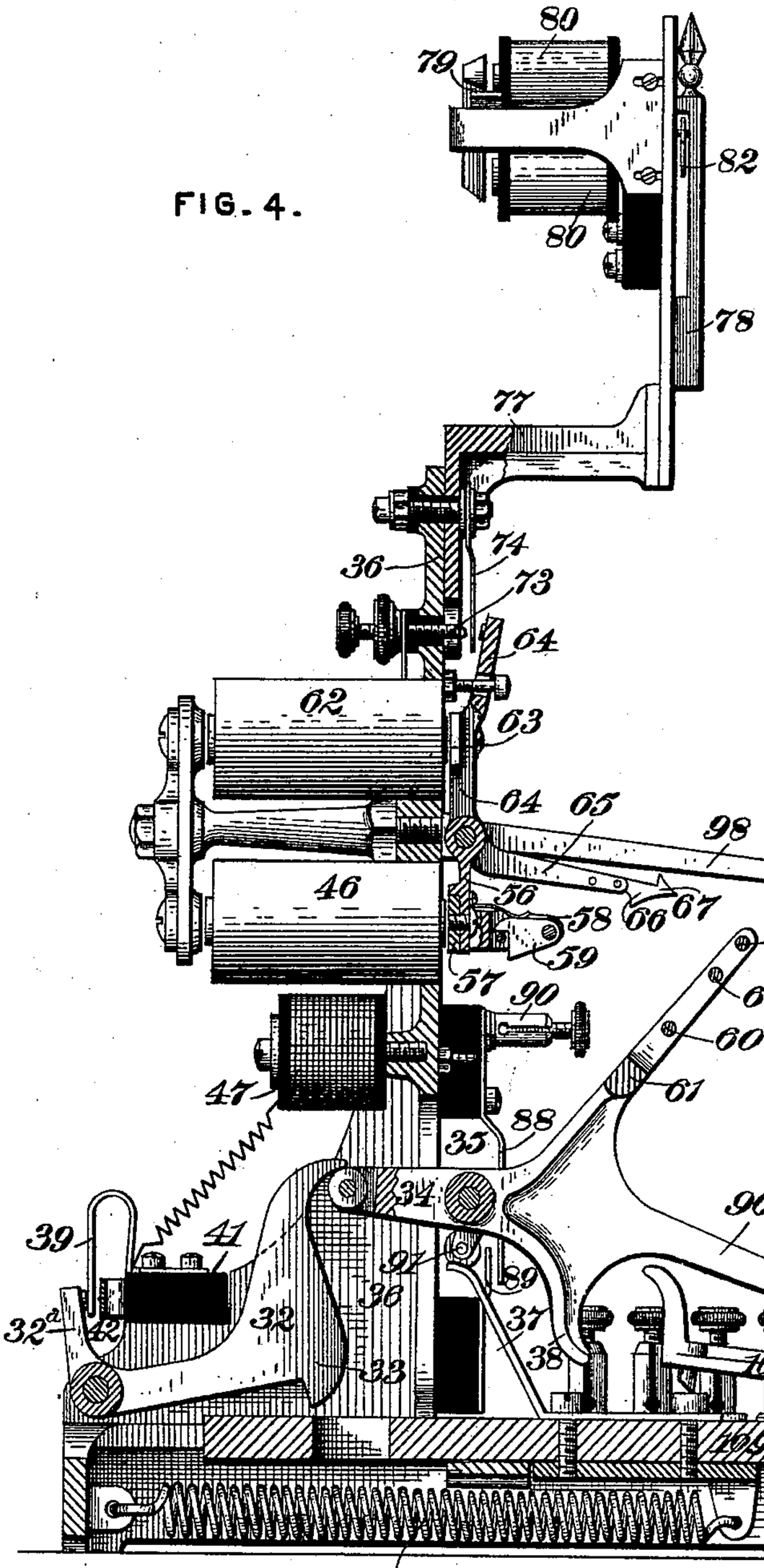
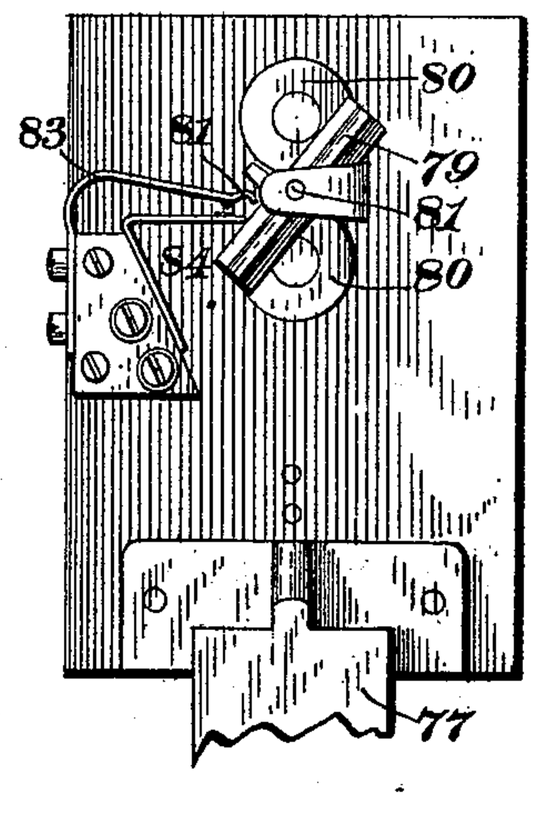


FIG. 7.



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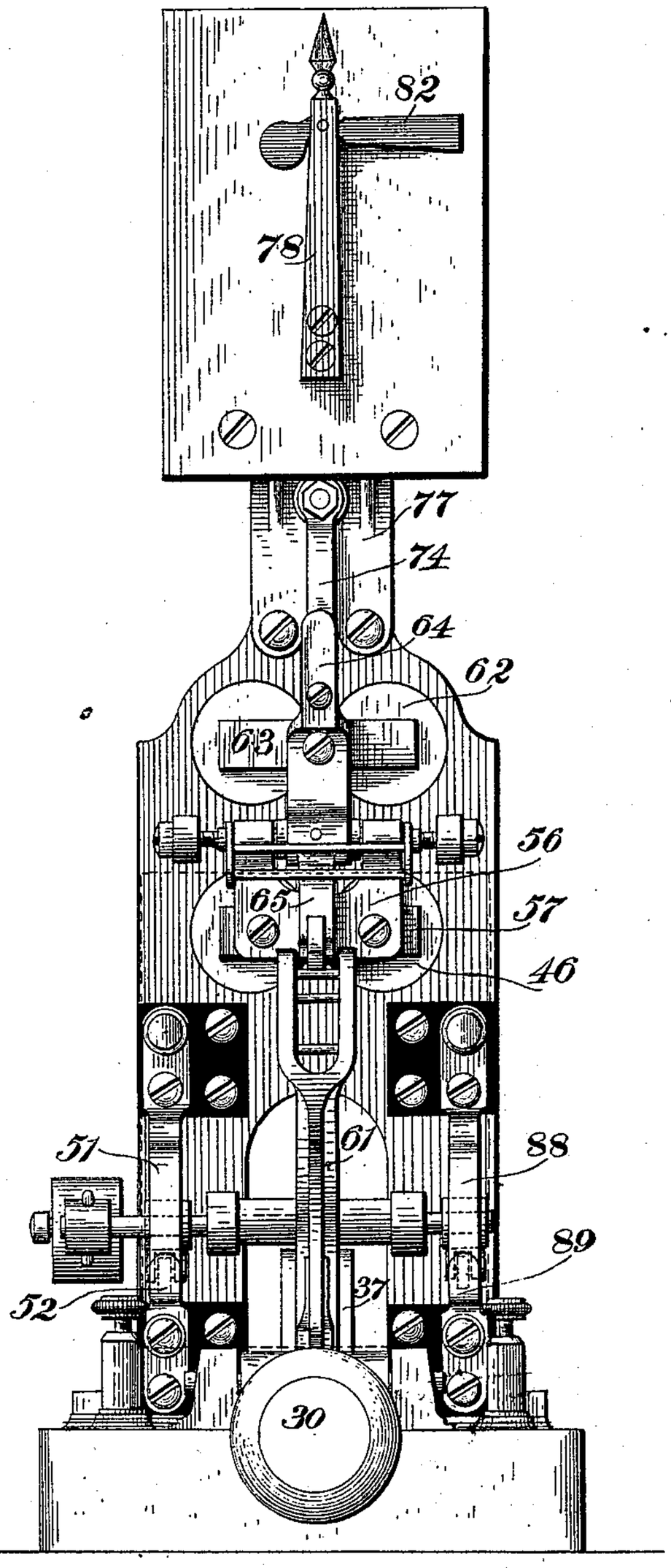
(No Model.) 7 Sheets—Sheet 6.

J. P. COLEMAN.

SIGNALING SYSTEM.

No. 539,354. Patented May 14, 1895.

FIG. 5.



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(No Model.) 7 Sheets—Sheet 7.

J. P. COLEMAN.

SIGNALING SYSTEM.

No. 539,354. Patented May 14, 1895.

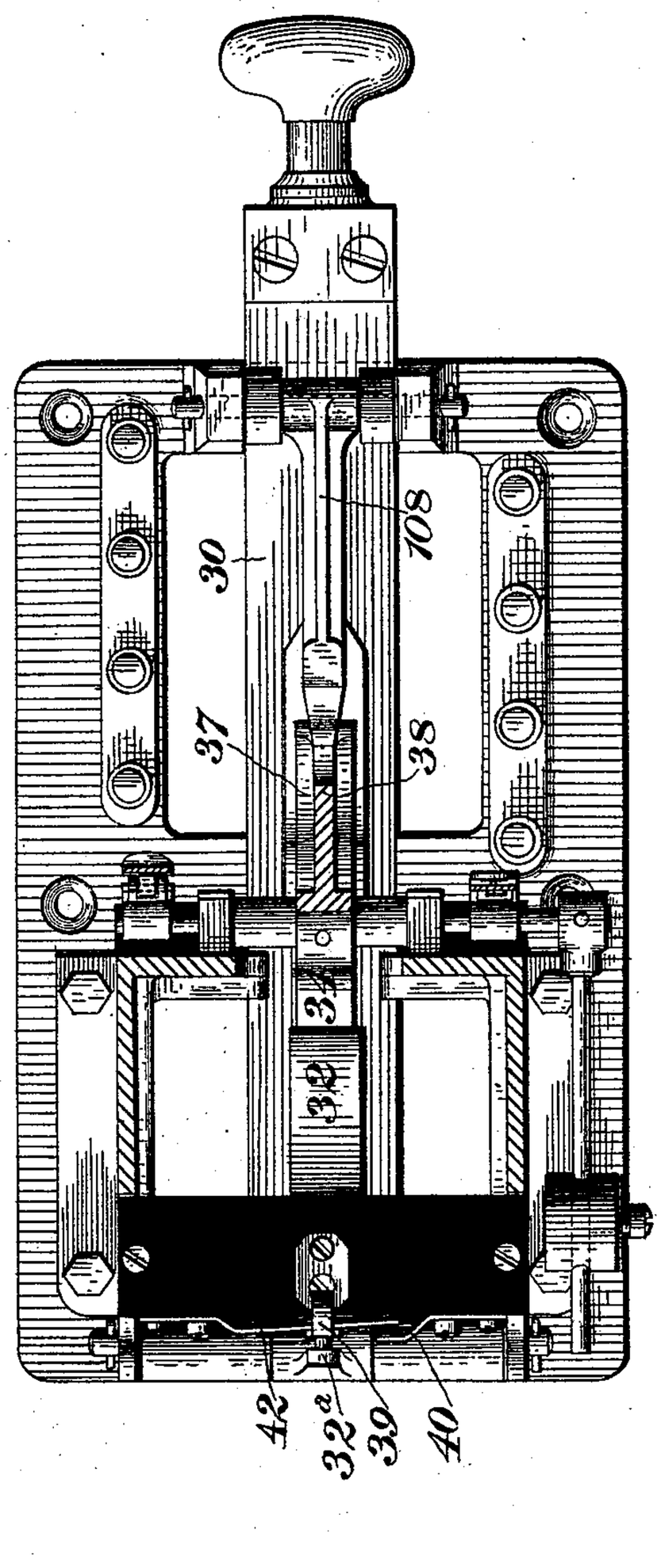

FIG. 6.

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UNITED STATES PATENT OFFICE.

JOHN PRESSLEY COLEMAN, OF SWISSVALE, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH AND SIGNAL COMPANY, OF SAME PLACE.

SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 539,354, dated May 14, 1895.

Application filed August 26, 1893. Serial No. 484,121. (No model.)

To all whom it may concern:

Be it known that I, JOHN PRESSLEY COLEMAN, a citizen of the United States, residing at Swissvale, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Signaling Systems, of which improvements the following is a specification.

The invention described herein relates to certain improvements in railroad signaling systems, and has for its object such an arrangement of electrically controlled locks for the signal operating mechanism and the circuits therefor, as will insure the locking of the signal at the end of a block section at normal or danger before the signal at the entrance to the section can be cleared.

It is a further object of the invention to prevent an operator at the end of a block section, after having unlocked the signal mechanism at the preceding station, and the signal cleared and again returned to normal after the passage of a train, to again unlock the signal mechanism until after the train has passed the station at the end of the block section.

In general terms the invention consists in the construction and combination substantially as hereinafter described and particularly claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a diagrammatic view illustrating the arrangement of the signal-operating mechanism and controlling-circuits at two adjoining stations. Fig. 1ª is a continuation of Fig. 1, illustrating certain modifications in the interlocking and indicating mechanism and the circuits therefor. Fig. 2 is a view similar to Fig. 1, showing the arrangement of the unlocking circuit, where a siding extends from the main line. Fig. 3 is a side elevation of the unlocking and indicating mechanism employed at stations C and D, the indicating-banner being at the intermediate position. Fig. 4 is a sectional elevation of the same, the several parts being at normal or free position. Fig. 5 is a front elevation of the indicating and unlocking mechanism, the banner being indicated by dotted lines. Fig. 6 is a sectional plan view of the same, the plane of section being indicated by the line *x x*, Fig. 3. Fig. 7 is a rear elevation of the upper portion of the indicating mechanism, and Fig. 8 is a detail view of the banner.

In the practice of my invention, the line of track is divided into a series of sections, and at the entrance to each section is placed a signal and mechanism, as indicated at A, B, C, and D, for operating the signal, and also controlling the operation of the signal of the preceding section. The arrangement of mechanism and circuits at and connecting stations A and B, illustrate a simple embodiment of my invention, while the mechanism and circuits at and connecting stations C and D, illustrate a more perfect and complete form of the invention.

At station A, the lever 1, which may or may not form a part of a large interlocking switch and signal mechanism, is connected by any suitable means to the "electric slot" 2, which in turn is connected to the signal 3. Any suitable construction of electric slot mechanism may be employed, such for example, as is shown and described in Letters Patent No. 308,494, dated November 25, 1894, or the form shown and described in an application, Serial No. 486,625, filed September 27, 1893.

The movement of the lever 1, for shifting the signal from normal or danger position to safety, is controlled by a locking mechanism consisting of a pivoted sector block 4, provided with projecting lug 5, connected to the lever 1, or its mechanical locking devices, and a finger 7 connected to the armature 8 of the electro-magnet 9. As shown, the mechanical locking devices of the lever 1 consist of a rocking slotted quadrant 10, a block 11 adapted to slide back and forth in the slot in the quadrant, and a latch rod 12, connected to the block 11. These devices and their manner of operation, are so well known in the art, that a more detailed description thereof is not deemed necessary. The mechanism consisting of the electro-magnet 9, armature 8, finger 7, and sector block 4, and electrical switches controlled thereby, are fully shown and described in an application, Serial No. 486,626, filed September 27, 1893. The signal operating and locking mechanism at B is similar to that at station A, and is designated by the same numeral with the character *b* an-

nexed. The circuit of the electro-magnet 9 is formed by the wire 13, make and break mechanism *a*, consisting of the armature and contact point of relay 14, forming part of track circuit between stations A and B, wire 15, make and break mechanism *b* consisting of a spring and contact point at station B, wire 16, battery 17, and wires 18, 19 and 20, wire 19 being common to all the stations. The make and break mechanism at *b* is controlled as shown, by the sector block 4^b, and is only closed so as to complete the circuit through electro-magnet 9 at A, when the lever 1^b has been shifted and locked in normal position, *i. e.*, in such position that its signal 3^b is at danger. If the lever at B is not in normal position, the circuit of magnet 9 is broken at *b*, so that the finger 7 will drop into the path of the sector block 4, thereby locking the lever 1 with its signal in normal position. Hence it is necessary for the operator at A to ask B to put his lever in normal position, thereby closing the circuit of magnet 9 at *b* before A can so shift his lever as to clear the signal 3.

As soon as the signal 3 is cleared, the train passes upon the track section between A and B, thereby cutting out relay 14 and permitting the armature of said relay to move away from its contact point and break the circuit of magnet 9 at *a*. The breaking of this circuit permits the finger to drop down on top of the sector block 4, which has been shifted to the position shown in dotted lines by the movement of the lever 1, in clearing signal 3, so that as soon as the sector block is moved from under the finger by the return of the lever 1 to normal position, the finger will drop behind the sector block and hold it and lever 1 in normal position until the circuit is closed at *a*. The circuit cannot, however, be closed at *a* until the train has passed off of the track section between A and B and restored the circuit of such track to normal, but the train cannot pass off this track section until B has cleared his signal. In shifting the lever 1^b so as to clear signal 3^b, the sector block 4^b is so shifted as to break the circuit of magnet 9 at *b*, so that although this circuit may be closed at *a*, by the passage of the train off of track section between A and B, it will remain open at *b* until lever 1^b and its signal are returned to normal or danger position. Hence it is necessary not only that the train must pass out of section between A and B, but also that said train must be protected by the return of signal 3^b to danger before the signal 3 can be cleared.

The electric slot 2 is employed at the starting point A, for the purpose of preventing the operator at A from holding his signal at safety, so that a second train may not enter section A to B before the first train has passed beyond station B. The circuit of said slot magnet is formed by the wire 21, make and break mechanism *c* formed by a second armature and contact point of relay 14, wire 22, electro-magnet 23, make and break mechanism *d* formed by armature and contact point of magnet 23, wires 24 and 25, battery 26, wire 27, common wire 19 and wire 21^c. As soon as the train enters upon the track section between A and B, the relay 14 is cut out, and the circuit of the magnet of the electric slot is broken, not only at *c*, but also at *d*. The breaking of this circuit permits the signal to go to danger regardless of the position of the lever 1. The second break at *d* is interposed in the electric slot circuit for the purpose of preventing the operator from throwing his lever forward to normal position, as soon as the train has passed beyond B, thereby restoring the break in the slot circuit at *c*, and without allowing his lever to lock, "pick up" the signal and shift it to safety without asking B. The make and break mechanism at *d* is formed by the armature and contact point of magnet 23, so that the break at *d* cannot be closed except by the excitation of the magnet 23, through some other circuit than that formed through its contact point and armature. This auxiliary circuit is formed by wire 21 extending from the slot 2, make and break mechanism *c*, wire 22, electro-magnet 23, wire 28, make and break mechanism *e*, consisting of a spring plate and contact point or other suitable construction, wires 29 and 25, battery 26, wire 27 and common wire 19. The make and break mechanism *e* is controlled by the sector block 4, or other movable part of the electric locking mechanism, and is only closed to complete the auxiliary circuit, when the lever 1 has been shifted to normal position and locked therein by the mechanical locking devices carried by said lever. The movement of these mechanical locking devices so shifts the sector block 4 as to close the circuit at *e*, and this movement is such that the finger 7 will drop behind the sector block, thereby locking it until released by B as described The mechanical closing of the auxiliary circuit at *e*, excites the magnet 23, so that its armature is drawn up against its contact point, thereby closing the main electric slot circuit. This main circuit is necessary in order to hold the slot mechanism locked, when the lever 1 is shifted to clear the signal, as this movement of the lever will break the auxiliary circuit at *e*.

From the foregoing, it will be readily understood that the signal 3 is shifted to normal position by the entrance of a train upon the section between A and B, and that it is necessary for A to shift his lever to normal position and lock it in such position, and also for the train to pass out of section between A and B before the connection between the lever and signal can be restored, and that the lever 1 having once been locked in normal position as described, cannot be shifted until B has shifted his lever and signal to normal position behind the train.

Before the train can proceed beyond B, it is necessary that the signal 3^b, which was placed at normal in order to unlock A, should be

cleared. When the lever and signal at B were placed at normal, the lever was locked by mechanical and electric devices similar to those heretofore described in connection with the lever 1 at A, but controlled by mechanism presently to be described at C. Hence before B can clear his signal 3^b, he must request C to unlock the lever at B.

At stations C and D the modified form of my invention including auxiliary locking devices and circuits, and also indicating devices, are employed. At stations C and D the mere locking of the levers 1^c and 1^d will not unlock the preceding signal operating mechanism, although the signal levers must be in normal position before the unlocking can be effected. The mechanism for unlocking the preceding signal is fully illustrated in Figs. 3 to 6 inclusive and the various make and break mechanisms and circuits of the unlocking mechanism are illustrated diagrammatically at stations C and D in Fig. 1^a. On the bed of this mechanism is arranged a sliding bar or plunger 30, which is normally held in by a spring 31, having its ends attached to the plunger, and a stationary part of the mechanism respectively. A locking dog 32 is pivoted in such relation to the plunger, that when free to move and the plunger is at the rear or inward limit of its movement, a projection 33 on the dog will drop into a hole in the plunger, thereby preventing any movement of the plunger until the dog is again raised. When the mechanism is in normal condition, the dog is held in a raised position free from the plunger, by an arm 34 on a rock shaft 35, mounted in suitable bearings in a vertical frame 36, secured to the bed of the machine. On the plunger is secured an angle piece 37, one part of which projects upwardly so as to strike against and shift an arm 38 projecting from the rock shaft 35, when the plunger is pulled out, thereby so shifting the arm 34, as to permit the dog to drop down. The movement of the plunger to shift the rock-shaft and the arm 34, is sufficient to remove the opening in the plunger out of line with the projection on the dog, which will then rest upon the plunger until the latter returns to its normal or inner position, when the dog will be free to drop and the projection will enter into the opening in the plunger and lock the same as against outward movement.

On a rock shaft carrying the dog 32, is formed an arm 32^a adapted when the projection on the dog drops into the opening in the plunger, to press a spring 39 against a spring 40, said springs being attached to a block 41 of insulating material secured to the frame of the machine and forming the make and break mechanism *f*. The continued movement of the arm 32^a will also force the spring 40 out of contact with the spring 42 also attached to the block 41, and forming in connection with spring 40, the make and break mechanism *g*. As indicated in the diagrammatic view, Fig. 1^a, the spring 39 is connected by a wire 43 to a binding post 44 on the machine. The spring 40 is connected by a wire 45 to one pole of an electro-magnet 46, secured as shown in Figs. 3 and 4 to the vertical frame 36, and the spring 42 is connected by a wire to one end of the resistance coil 47 also attached to the frame 36; the opposite end of the resistance coil being connected by a wire 48 to a binding post 49. The other pole of the magnet 46 is connected by a wire 50 to a spring 51, adapted to be forced into contact with a spring 52, by an arm 53 on the rock shaft 35, as the shaft is rotated by the outward movement of the plunger, as described. These springs 51 and 52 are attached to blocks of insulating material secured on the frame 36, and form the make and break mechanism *h*. The spring 52 is connected by a wire 54 to a binding post 55 on the machine.

On the swinging carrier 56 of the armature 57 of the magnet 46, is formed a slotted projection 58, in which is pivoted a spring actuated pawl 59 adapted to engage a cross bar 60 in the slotted end of the arm 61, carried by the rock shaft 35, when said arm is thrown up by the outward movement of the plunger as described. This spring actuated pawl 59 is so arranged as to remain in engagement with the cross-bar 60 only while the armature 57 is held against the magnet 46. As soon as the magnet is demagnetized, the weight of the several arms on the rock shaft 35 will swing the carrier 56 out, thereby releasing the cross-bar from engagement with the pawl. A second magnet 62 is attached to the vertical frame 36 above the magnet 46. The armature 63 of this magnet is secured to the arm 64 of a bell crank lever and at or near the end of the other arm 65 of the lever are formed shoulders or stops 66 and 67 on the under and upper sides respectively of the arm. This arm 65 is arranged to pass through the slot in the arm 61 on the rock shaft 35 when said arm is raised, as hereinbefore stated. As the arm 61 swings down, when the magnet 46 is cut out as stated, its movement will be arrested by a cross-bar 68 in the slot in the arm 61 coming into contact with the shoulder or stop 66 on the under side of the arm 65 of the bell crank lever, provided the armature 63 is not attracted to its magnet 62, as is the case when the magnet 46 is cut out to permit the arm 61 to drop. The arm 61 having been arrested by the stop 66, it is necessary in order to permit said arm to complete its downward movement, that the circuit through magnet 62 should be first closed, thereby attracting its armature and raising the arm 65 sufficiently to allow the cross-bar 68 to clear the stop 66, whereupon the arm 61 will drop a short distance, being again arrested by the upper cross-bar 69 in the slot of said arm coming into contact with the shoulder or stop 67, which has been shifted into the path of movement of the cross-bar 69 by the upward movement of the arm 65, as described. In order to release the cross-bar 69 from the stop 67

and permit the arm 61 to drop entirely down, the magnet 62 must be cut out, thereby permitting the arm 65 to drop, carrying the stop 67 out of the path of movement of the cross-bar 69.

One pole of the magnet 62 is connected by a wire 70 to the binding post 55, and the other pole is connected by a wire 71 to a binding post 72. A second connection is made from this pole of the magnet 62 to a contact point or spring 73, with which a spring 74 is adapted to be forced into contact by the arm 64 carrying the armature 63 of the magnet 62, when said magnet is excited. These springs are attached to but insulated from the vertical frame 36 and form the make and break mechanism *i*. The spring 74 is connected by a wire 75 with a binding post 76.

On a bracket 77 is attached a miniature signal post 78, and also an electro-magnet 80, having an armature 79 triangular in cross-section and attached to a shaft 81 mounted in suitable bearings in the bracket 77. On the opposite or front end of the shaft 81 is attached a miniature semaphore blade 82. The armature is normally held by a spring 83, bearing against a pin on the shaft 81, so that its apex is out of line with the pole of the magnet, the signal 82 being at the same time at normal or danger position. As soon as the magnet is excited the armature will be shifted so that its apex is in line with the pole of the magnet, thereby shifting the miniature signal or indicator to safety position. The movement of the armature when the magnet is excited, presses the spring 83 against another spring or contact point 84, said springs being secured to but insulated from the bracket 77, and forming the make and break mechanism *j*. The spring 83 is connected by a wire 85 to a binding post 86, which is also connected to the binding post 55, as shown in the diagrammatic views C and D, Fig. 1[a], and the spring 84 is connected by a wire 87 to a spring 88 normally in contact with a spring 89, which is connected to the binding post 90. The spring 88 and the spring 89 with its binding post 90 are secured to the vertical frame 36 in such relation to the rock shaft 35, that a projection 91 thereon will force one of said springs away from the other when the rock shaft is rotated by the outward movement of the plunger as described. The springs 88 and 89 forming the make and break mechanism *k* are separated at the same time or nearly so that the springs 51 and 52 are forced into contact with each other.

One pole of the magnet 80 is connected by a wire 92, to the binding post 93 and the opposite pole of the magnet is connected by a wire 94 to the binding post 95.

The rock shaft 35 is provided with another arm 96 having the lower end of a banner 97 attached thereto. The upper end of the banner is connected to an arm 98, having its inner end pivotally attached to the vertical frame 36, and serving merely to maintain the banner in a vertical position, while it is being raised or lowered by the arm 96. On the banner are placed the words "Free," "Train in Block" and "Locked," or words of like import, in such manner that when the banner is down the word "Free," will appear at the slot in the case covering the unlocking and indicating mechanism, indicating that the train has passed beyond the station and that the signal has been shifted to and locked in normal position. When the banner has been raised by the outward movement of the plunger, the word "Locked" will appear at the slot in case, indicating that the operator has unlocked the signal at the preceding station and that his unlocking mechanism and lever locking mechanism are locked and cannot be shifted. When the banner has dropped to the intermediate position as it will do when the magnet 46 is cut out as described, the words "Train on block" will appear at the slot in the case, thereby indicating that the train has passed the preceding station, and warning the operator to ask the next succeeding station to unlock his signal.

The circuit for the magnet 9^b of the lever locking mechanism at station B is formed by the wire 99, make and break mechanism *l* consisting of the armature and contact point of track relay 14^b, wire 100, binding post 44, wire 43, springs 39 and 40 of make and break mechanism *f*, wire 45, magnet 46, wire 50, springs 51 and 52 of make and break mechanism *h*, wire 54, binding post 55, wire 101, battery 102, wire 103, common wire 19 and wire 104 to opposite pole of magnet 9^b.

The train having arrived at station B, as stated, the operator asks C to unlock his lever in order that signal 3^b may be cleared. The operator at C thereupon pulls out the plunger 30, thereby through the medium of the angle piece 37 and arm 38, so shifting the rock shaft 35, that the arm 34 is moved down away from the dog 32, permitting the projection to rest upon the plunger. The same movement of the rock shaft raises the arm 61, so that the cross-bar 60 will engage the spring pawl 59 on the corner of the armature 57 of the magnet 46, and also so shifts the arm 53 as to force the spring 51 into contact with the spring 52. The closing of this make and break mechanism *h* completes the cautionary circuit consisting of the battery 102, wires 103 and 104 springs 105 and 106 forming make and break mechanism *m*, wire 107, binding post 49, wire 48, resistance coil 47, springs 42 and 40 of make and break mechanism *g*, wire 45, magnet 46, wire 50, springs 51 and 52 of make and break mechanism *h*, wire 54, binding post 55 and wire 101 to opposite pole of battery. As stated, this circuit is closed so as to excite the magnet 46 and thereby hold the arm 61 up through the medium of the magnet 46, provided that the make and break mechanism at *m* is closed. This make and break mechanism *m* is so connected to the locking finger 7^c of the electric locking mechanism of the sig-

nal lever 1^c, as to be closed only when the finger 7^c has dropped into locking position in front of the sector block 4^c, and as hereinbefore stated, the finger 7^c can assume this locking position only when the lever 1^c is locked in such position to hold the signal 3^c at normal or danger position. If this cautionary circuit could not be closed by the outward movement of the plunger 30, as described, so as to hold the arm 61 up, the arm 61 would when the plunger is released, drop back until arrested by the stop 66 on the arm 65, and thereby permit a hook 108 to drop and engage a shoulder or projection 109 on the plunger. This hook, which is held out of the line of movement of the shoulder on the plunger by the arm 38, when the arm 61 is held up, will, when released, as stated, prevent such a return movement of the plunger that the projection on the dog 32 can drop into the opening in the plunger. As such downward movement of the dog as is produced by the entrance of the projection 33 into the opening in the plunger is necessary in order to close the circuit through the lever locking magnet 9^b, it is evident that the cautionary circuit through the make and break mechanism *m* must be closed and this is possible only when the lever 1^c is locked at normal position, before C can unlock B.

If the lever 1^c is locked in normal position, the cautionary circuit will be closed by the outward movement of the plunger and the armature carrier will be drawn by the magnet 46 into such position that the pawl 59 will engage the cross-bar 60 and hold the arm 61 in its raised position. While the arm 61 is held in this position, the arm 38 will hold the hook out of the path of movement of the stop 109 on the plunger so that the plunger can be returned to its normal position by the spring 31, when released by the operator. The return of the plunger to normal position brings the opening therein into line with the projection on the dog 32, so that the dog will drop, thereby so shifting the arm 32^a as not only to press the spring 39 against the spring 40, but also by its continued movement press the spring 40 away from the spring 42. Thus the dropping of the projection on the dog 32 into the opening in the plunger not only locks the plunger, but also completes the unlocking circuit through the magnets 46 and 9^b at the make and break mechanism *f*, and breaks the cautionary circuit through the magnet 46 at the make and break mechanism *g*. It will be observed that the breaking of the cautionary circuit is dependent upon the prior completion of the unlocking circuit, so that the arm 61 is not released from the pawl 59 by the break in the cautionary circuit, but will be retained in position by the closure of the unlocking circuit, until said circuit is broken as hereinafter stated. The operator at C having by the outward pull and release of the plunger closed the unlocking circuit through magnet 9^b, the locking finger 7^b is raised thereby, so that the operator at B can shift his lever and clear the signal 3^b, permitting the train to pass on toward C.

The movement of lever 1^b in clearing the signal breaks the unlocking circuit to station A, at make and break mechanism *b*, so that the signal at A cannot be cleared until B mechanically locks his lever at normal position, although the unlocking circuit to A may be otherwise complete.

A short track circuit is placed in the track between the stations B and C, preferably near the station B, as indicated at F, in which is included the relay 14^b. As the train enters upon this track circuit, the relay 14^b is cut, thereby breaking the unlocking circuit at *l*. This break in the unlocking circuit permits the armature carrier 56, the magnet 46 being demagnetized, to swing out, thereby releasing the arm 61, which then swings down until checked in the intermediate position by the stop 66 on arm 65 engaging the cross-bar 68 on the arm 61, as hereinbefore described. This downward movement of the arm 61 and consequent rotation of the rock shaft 35 will so move the arm 91, as to allow the springs 88 and 89 to come together, they having been separated when the arm 61 was raised; and the upward movement of the arm 34, which is not sufficient to raise the projection 33 from the opening in the plunger, will so shift the dog 32 with its arm 32^a, that the springs 40 and 42 will again come into contact. These contacts at *g* and *k* are completed without breaking the contacts at *f* and *h*.

As the train approaches station C, it enters upon track circuit indicated at E, thereby cutting out the relay 14^c and breaking the circuit of which make and break mechanism *n*, consisting of armature 110 and contact point 111, forms a part, and at the same time completing the circuit of which the make and break mechanism *o*, consisting of armature 110 and contact point 112, forms a part. The circuit thus completed consists of the contact point 112, wire 113, binding post 72, wire 71, magnet 62, wire 70, binding post 55, wire 101, battery 102, wire 103, common wire 19, wire 114, and armature 110. By the closure of the circuit the armature 63 is attracted to its magnet, thereby so shifting the arms 64 and 65 that the stop 66 is moved out of engagement with the cross-bar 68 on the arm 61, the stop 67 is moved into the line of movement of the cross-bar 69, checking the arm 61, and the spring 74 is shifted into contact with the point or spring 73, thereby closing a retaining circuit through the magnet 62. This retaining circuit consists of the contact point or spring 73, spring 74, wire 75, binding post 76, wire 115, contact point 116 and spring 117 of make and break mechanism *p*, wires 118 and 103, battery 102, wire 101, binding post 55, wire 70, magnet 62 and wire connecting the other pole of the magnet with contact point or spring 73.

The signal 3^c is preferably located about

midway of the track section E, so that the main circuit through the magnet 62 completed by the entrance of the train onto section E, will not be broken by the passage of the train off the section until the train has passed by the signal. In clearing the signal for the onward movement of the train, the sector block 4^c is so shifted as to permit the spring 117 to move into contact with the point 116, thereby closing the retaining circuit through the magnet 62 at *p*, it having been previously closed at *i*, as hereinbefore stated. The retaining circuit having been closed by clearing the signal 3^c, it will remain in that condition until the signal lever has been shifted and locked in normal position, thereby through the medium of the sector block forcing the spring 117 away from the point and breaking the retaining circuit. While the arm 61 is retained in an elevated position by the stop 67, the banner 97 is held in such position, that the words "Train on block" appear to the operator, a train being considered in the block between B and C until it has passed off of the track section E, adjacent to the signal 3^c, and the latter shifted to normal position. As heretofore stated, the passage of the train off of the track section E breaks the main circuit through magnet 62 at *o*, and the locking of the signal lever 1^c breaks the retaining circuit through the same magnet, thereby releasing the arm 65 so that it will drop down, releasing the cross-bar 69 from the stop 67 and permitting the arm 61 and the banner to drop to the full limit of their movements, in which position the banner will show "Free" to the operator, indicating that he is now at liberty to unlock the signal at B. The downward movement of the arm 61, not only raises the arm 34 so that it will lift the dog sufficiently to remove the projection 33 from opening in the plunger and to permit the spring 39 to move back out of contact with the spring 40, but also so shifts the arm 53, as to permit the springs 51 and 52 to separate, or assume normal position.

As in the cases of the stations A and B, the magnet 9^c must be excited so as to shift the finger 7^c out of the path of the sector block 4. The circuit of this magnet consists of the wire 119, springs 120 and 121 of make and break mechanism *q*, common wire 19, wire 103, battery 102, connected binding posts 55 and 86, wire 85, springs 83 and 84, wire 87, springs 88 and 89, binding post 90 and wire 122. It will be observed that the make and break mechanism *j* of this circuit is controlled by the magnet 80, as hereinbefore described, so that the circuit of this magnet must be closed before the circuit of magnet 9^c can be completed. The circuit for the magnet 80, consists of the wire 94, binding post 95, wire 123 extending to the unlocking and indicating mechanism at station D, binding post 124, wire 125, springs 126 and 127 of make and break mechanism *r*, wire 128, magnet 129, wire 130, springs 131 and 132 of make and break mechanism *s*, wire 133, binding post 134, wire 135, battery 136, wires 137 and 138, contact spring and point 139 and 140 of make and break mechanism *t*, wire 141, contact point and armature 142 and 143 of the relay 14^d, wire 144, common wire 19, extending back to station C, wires 103 and 118, contact spring 117, point 145, wire 146, binding post 93, and wire 92; or from common wire 19 the current may pass by wire 114, armature 110, contact 111, wires 141^c and 146, binding post 93 and wire 92 to magnet 80, the other portions of the circuit of magnet 80 being as hereinbefore described.

The operator at C having asked the operator at D to unlock his (C's) signal lever, the operator at D will pull out his plunger 30, thereby throwing the arm 61 up, so that its cross-bar 60 will engage the spring pawl 59 and be retained thereby, provided that the cautionary circuit at D is closed. This current consists of the battery 136, wires 137 and 147, springs 148 and 149 of make and break mechanism *u*, wire 150, binding post 151, wire 152, resistance coil 153, contact springs 154 and 127 of make and break mechanism *v*, wire 128, magnet 129, wire 130, contact springs 131 and 132 of make and break mechanism *s*, wire 133, binding post 134, and wire 135. The cautionary circuit must be closed so as to hold the armature 57 against the poles of its magnet 129, and prevent the dropping of the arm 61, and consequent lifting of the dog 32 by the arm 34. As hereinbefore described, the make and break mechanism *s* is closed by an arm on the shaft 35, which is rotated by the plunger when pulled out. The return movement of the plunger will, as hereinbefore described, permit the dog 32 to drop and through the medium of the arm 32^a press the spring 126 against the spring 127, thereby closing the circuit through the magnet 80 at station C. The closing of this circuit so shifts the armature 79, as to press the springs 83 and 84, thereby closing at *j* the unlocking circuit through 9^c and also so shift the miniature signal 82 to clear, thereby indicating to operator at C that the operator at D has done his part toward unlocking lever 1^c. Having received the indication that unlocking circuit is closed at *j*, the operator at C presses upon the pin 155, thereby closing the make and break mechanism *q* in the unlocking circuit. The closing of the locking circuit through magnet 9^c so shifts the armature 8^c as to move the finger 7^c out of line with the sector block 4^c. The operator at C is now free to shift his lever to clear the signal 3^c.

It will be understood that the signal must be cleared before the train can pass off of section E, and hence banner 67 will not drop to indicate "Free" until after the train has passed off of section E and the signal 3^c restored to normal as hereinbefore stated. As soon as the banner indicates "Free" the operator at C is at liberty to pull his plunger and unlock the signal lever at B, so as to permit a train to enter the block between B and C.

It will be observed that the make and break mechanism *k* formed by the springs 88 and 89, in the unlocking circuit of magnet 9^c is opened by the movement of the rock shaft when the plunger 30 is pulled out to close the unlocking circuit of magnet 9^b, thereby rendering it impossible for the operator at D to unlock C until by the passage of the train over track section F at station B, the rock shaft is permitted to rotate back sufficiently far to close the make and break mechanism at *k*, as hereinbefore described. The interposition of this make and break mechanism in the unlocking circuit renders it impossible for all the operators along the line to unlock each other and set their signals at clear, for although the operator at C may shift his plunger to unlock B, he at the same time opens his own unlocking circuit at *k*, so that although the operator at D may shift his plunger to unlock C, the latter's unlocking is broken at *k* and will remain so until the train has passed over track section F.

It frequently occurs that a siding is arranged between two stations, the entrance to the siding being located near one of the stations as indicated at S in Fig. 1. In such a case it is necessary to provide means whereby a train at B may pass into the siding beyond the signal 3^b and the track section F, without so locking up the unlocking and indicating mechanism at C, as to prevent the operator at C from unlocking B, after the train has entered the siding. As hereinbefore stated, the passage of a train over track section F, breaks the unlocking circuit of B at *l*, and that the plunger 30 at C having been pulled out and released to unlock B, is on its return so locked by the dog 32, when the unlocking circuit is broken at *l*, that it cannot be unlocked, except by the passage of a train over the track section E. Hence it is necessary to provide means whereby the unlocking circuit from C to B, may be kept closed while a train is passing over track section F and entering the siding. This result is effected by means of a shunt circuit consisting of the wires 156 and 157 connected respectively to the wires 19 and 100 of the unlocking circuit and the make and break mechanism at *w*. This make and break mechanism may be of any suitable construction and is arranged to be closed to complete the circuit when the movable rails of the siding are shifted to permit of the entrance of a train onto the siding. It will be readily understood that with this shunt circuit the unlocking circuit will be held closed while the train is passing over track section F, and hence the unlocking and indicating mechanism will not be locked.

As shown in Fig. 2, the track circuit between stations A and B may be employed as the unlocking circuit. In this arrangement the circuit of the magnet 9 is a local circuit and has included therein the make and break mechanism *a* consisting of the contact point and armature 14 of the track circuit, and the make and break mechanism *b* is included in the track circuit.

The orderly movements of the several parts of the unlocking and indicating mechanism at D occurs as described in connection with the mechanism at C. The several circuits and make and break mechanism described as being at C are also found at D, and at each block station along the line of the road.

It will be readily understood by those skilled in the art that track instruments may be employed in lieu of the track circuit and relay, as shown and described, and that other forms or constructions of make and break mechanism may be substituted for those herein described.

I claim herein as my invention—

1. In a signaling system, the combination of two or more signals and their controlling mechanisms located at different stations, an electric lock for holding the signal controlling mechanism at each station at normal or danger, an unlocking circuit extending from one station to the next succeeding station, and a single make and break mechanism in the unlocking circuit and located at the succeeding station, and arranged to be operated by the signal controlling mechanism of that station when shifted to danger, whereby simultaneously to shift the signal to danger at one station, and unlock the signal controlling mechanism at the preceding station without the necessary use of any other or additionally manually actuated circuit closer at either station, substantially as set forth.

2. In a signaling system, the combination of two or more signals and their controlling mechanisms located at different stations, an electric lock for holding the controlling mechanism at each station at normal or danger, an unlocking circuit extending from one station to the next succeeding station, and a single make and break mechanism in the unlocking circuit, and suitably arranged at the succeeding station for automatically closing the circuit on the shifting of the signal to normal or danger, without the necessary use of a manually actuated circuit closer at such succeeding station and thereby simultaneously unlock the signal controlling mechanism at the preceding station, substantially as set forth.

3. In a signaling system, the combination of two or more signals and their controlling mechanism, located at different stations, an electric lock for holding the controlling mechanism at each station at normal or danger, an unlocking circuit extending from one station to the next succeeding station, a make and break mechanism included in the unlocking circuit at the succeeding station and arranged to be closed by the signal controlling mechanism when shifted to place the signal at normal, a track circuit extending between adjacent stations, and a make and break mechanism arranged in the unlocking circuit and controlled by the relay in the

track circuit, whereby the presence of a train between two stations will hold the unlocking circuit open, locking the signal controlling mechanism as against clearing the signal, substantially as set forth.

4. In a signal system, the combination of two or more signals, and their controlling mechanisms, located at different stations, manually operated locking devices, (as per catch rod and quadrant) for holding the controlling mechanism at normal or danger, an electric lock (as at 4^b) as an additional or double lock for holding the signal controlling mechanism at each station in normal position, an unlocking circuit extending from one station to the next succeeding station and a make and break mechanism located in the unlocking circuit at the succeeding station and arranged to be closed by the manually operated locking devices when locking the signal controlling mechanism at normal or danger, and thereby unlock the manually operated locking device of the signal controlling mechanism at the preceding station, substantially as set forth.

5. In a signaling system, the combination of a signal, mechanism for operating the signal, means for locking the signal operating mechanism at normal, an electric slot interposed in the connections between the signal and its operating mechanism, a relay and armature included in the main slot circuit, an auxiliary slot circuit passing through the relay, a make and break mechanism included in the auxiliary circuit, and controlled by the locking devices of the signal operating mechanism, and a second make and break mechanism in the slot circuit and adapted to be opened by the passage of a train beyond the signal, whereby the operator is compelled to lock his signal operating mechanism at normal in order to close the slot circuits after being broken by the passage of a train beyond the signal, substantially as set forth.

6. In an electric signaling system, the combination of two signals and their operating mechanisms arranged at separate stations, an electric lock at each station for holding the signal mechanism at normal, an unlocking circuit extending from the locking mechanism at one station to the succeeding station, a make and break mechanism arranged in said unlocking circuit at the succeeding station, a cautionary circuit at the latter station, and a make and break mechanism in the cautionary circuit controlled by the signal locking mechanism at the second station, the unlocking and cautionary circuits being so arranged that the closing of the unlocking circuit is dependent upon the closing of the cautionary circuit by the locking of the signal of the second station at normal or danger, substantially as set forth.

7. In an electric signaling system, the combination of two signals and their operating mechanisms arranged at separate stations, electric locks for holding the signals at normal or danger, an unlocking circuit, a circuit extending to the succeeding station and containing a relay a make and break mechanism in the unlocking circuit controlled by said relay in the circuit extending to the succeeding station, a make and break mechanism in said circuit at the succeeding station, and a make and break mechanism in the unlocking circuit at the first station, and arranged to be operated by the foot or hand of the operator, whereby the closure of a circuit at both stations is necessary for the unlocking of the signal at the first station, substantially as set forth.

8. In a signaling system, the combination of a movable plunger, a rock shaft oscillated by the plunger when pulled outward, a pivoted dog provided with a projection adapted to enter an opening in the plunger, an arm on the rock shaft for normally supporting the dog, a locking arm for preventing a return movement of the rock shaft, a catch for engaging the locking arm when raised, an electro-magnet controlling the catch a cautionary circuit including said magnet and a make and break mechanism in the cautionary circuit of the magnet and arranged to be closed on the outward movement of the plunger, substantially as set forth.

9. In a signaling system, the combination of a movable plunger, a dog adapted when free to move, to engage the plunger, a rock shaft provided with an arm for supporting the dog and adapted to be oscillated by the plunger when pulled outward, a locking arm for preventing a return movement of the rock shaft, a catch for engaging the locking arm when raised, an electro-magnet controlling the catch, a cautionary circuit including said magnet a make and break mechanism in the cautionary circuit of the magnet arranged to be closed on the outward movement of the plunger, and a make and break mechanism in the circuit passing through the electro-magnet and extending to the preceding station, the make and break mechanism being adapted to be closed by the downward movement of the dog to lock the plunger, substantially as set forth.

10. In a signaling system, the combination of a movable plunger, a dog adapted when free to move, to engage the plunger and prevent any outward movement thereof, a hook for preventing an inward movement of the plunger, a rock shaft provided with arms for supporting the dog and hook, and adapted to be oscillated by the plunger when pulled outward, a locking arm for preventing a return movement of the rock shaft, a catch for engaging the locking arm when raised, an electro-magnet controlling the catch, a cautionary circuit including said magnet a make and break mechanism in the cautionary circuit of the magnet arranged to be closed on the outward movement of the plunger, and a make and break mechanism in the circuit passing through the electro-magnet and extending to

the preceding station, and arranged to be closed by the movement of the dog in locking the plunger as against outward movement, substantially as set forth.

11. In a signaling system, the combination of a rock shaft provided with an arm carrying an indicating banner or device, a plunger for oscillating the rock shaft, a locking arm connected to the rock shaft, an electro-magnet, a catch adapted to engage the locking arm and controlled by the armature of the magnet, a make and break mechanism in the circuit of the electro-magnet, and a track circuit provided with a relay controlling the make and break mechanism, whereby the entrance of a train on the track circuit will so shift the make and break mechanism as to close the circuit through the magnet and thereby so shift the armature and catch as to release the locking arm, substantially as set forth.

12. In a signaling system, the combination of a movable plunger, a dog adapted when free to move, to engage the plunger and prevent any outward movement thereof, a rock shaft provided with an arm adapted to raise the dog from engagement with the plunger, a locking arm for preventing a return movement of the rock shaft, an electro-magnet, a catch adapted to engage the locking arm and controlled by the armature of the magnet, a retaining circuit passing through the magnet, a make and break mechanism arranged in said circuit, and signal mechanism arranged to so shift the make and break mechanism when the signal is locked at normal, as to break the retaining circuit through the magnet, whereby the locking arm is released from the catch thus permitting a return movement of the rocking shaft and the disengagement of the dog from the plunger, substantially as set forth.

13. In a signaling system, the combination of a plunger, a dog adapted when free to move, to engage the plunger and prevent any outward movement of a rock shaft operated by the plunger and provided with an arm adapted to raise the dog from engagement with the plunger, a locking arm for preventing a return movement of the rock shaft, an electro-magnet, a double catch adapted to engage to the locking arm, and controlled by the armature of the magnet, a main circuit passing through the magnet, a make and break mechanism in said circuit, a track circuit provided with a relay controlling the make and break mechanism so as to close the main circuit as the train enters the track circuit and open the main circuit as the train passes off the track circuit, a retaining circuit also passing through the magnet, a make and break mechanism in the retaining circuit, and signal mechanism arranged to so shift the make and break mechanism, when the signal is locked at normal as to open the retaining circuit, substantially as set forth.

14. In a signaling system, the combination of an indicating banner, a plunger for raising the banner, electrically controlled mechanism for supporting the banner in its highest position electrically controlled catch devices for supporting the banner in two or more positions, a local cautionary circuit for temporarily supporting the banner, an unlocking circuit extending to the preceding station for supporting the banner on the opening of the cautionary circuit, a make and break mechanism in the unlocking circuit at the preceding station and controlled by the movement of trains past such station, a local circuit partially releasing the banner, a make and break mechanism in said circuit controlled by the passage of a train along the track a retaining circuit for finally releasing the banner, and a make and break mechanism controlled by the signal operating mechanism, substantially as set forth.

15. In a signaling system, the combination of signal operating mechanism, an electrically controlled lock for such mechanism, a circuit for the lock, a make and break mechanism arranged in circuit, an electrically controlled indicating device for operating the make and break mechanism, a circuit for said indicating device extending to the next succeeding station, and a make and break mechanism in the circuit at such station, substantially as set forth.

16. In a signaling system, the combination of a series of two or more signals and their operating mechanisms arranged at separate stations, as C, D, &c., an electric lock at each station for holding the signal mechanism at normal or danger, unlocking circuits extending from one station to the next succeeding station, as from B to C, and from C to D, &c., a make and break mechanism (as *f*) at each station, and controlling the circuit to the preceding station, and a second make and break mechanism (as *k*) at each station controlling the circuit of the signal locking mechanism at that station, said circuit being also controlled at the next succeeding station, the second make and break mechanism being adapted to be operated to prevent the unlocking of the signal at its station when the first make and break mechanism is shifted to unlock the signal mechanism to the preceding station, substantially as set forth.

In testimony whereof I have hereunto set my hand.

JOHN PRESSLEY COLEMAN.

Witnesses:
DARWIN S. WOLCOTT,
F. E. GAITHER.