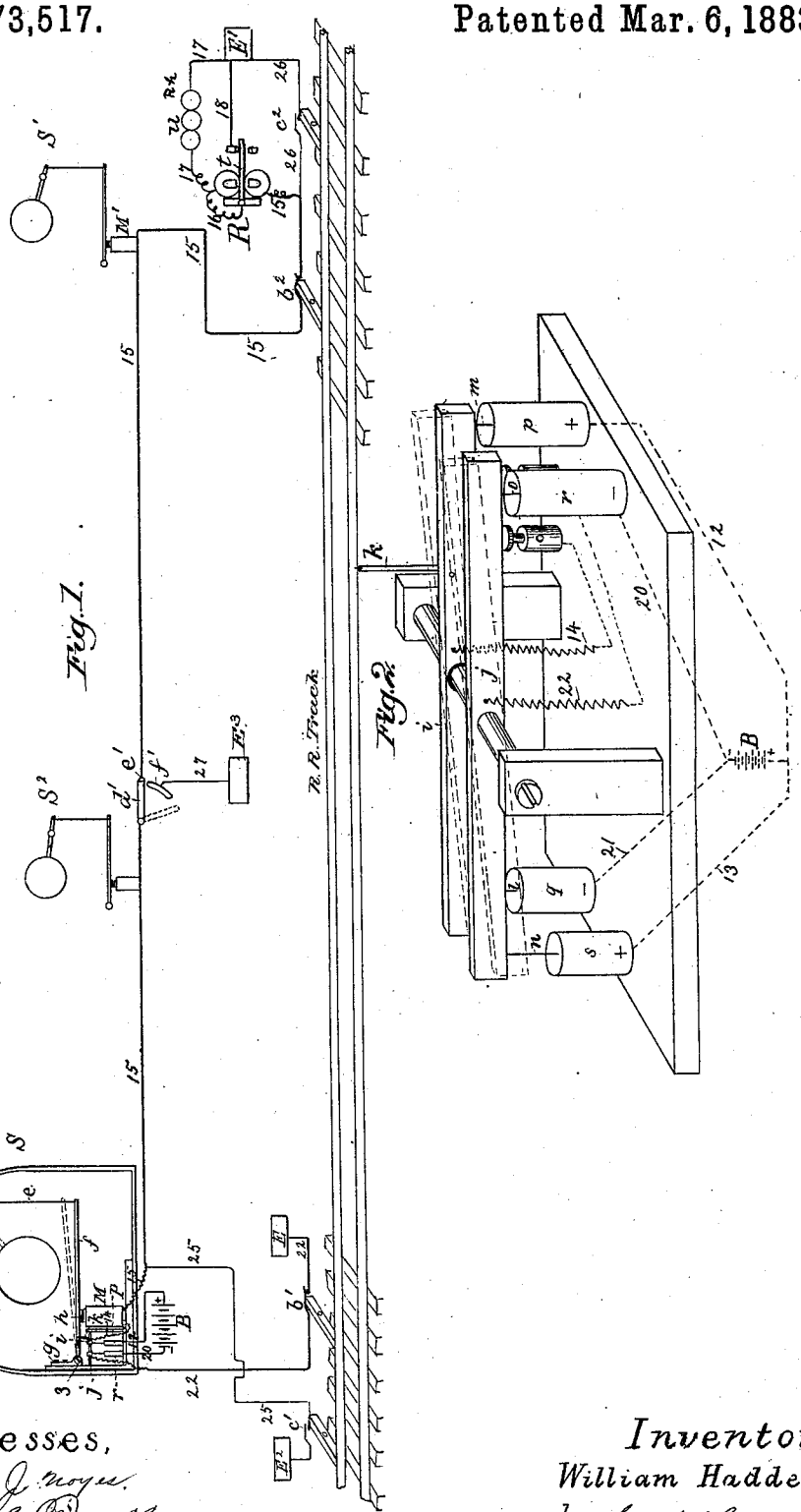
(No Model.) 2 Sheets—Sheet 1.

W. HADDEN.

RAILWAY SIGNAL APPARATUS.

No. 273,517. Patented Mar. 6, 1883.



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(No Model.) 2 Sheets—Sheet 2.

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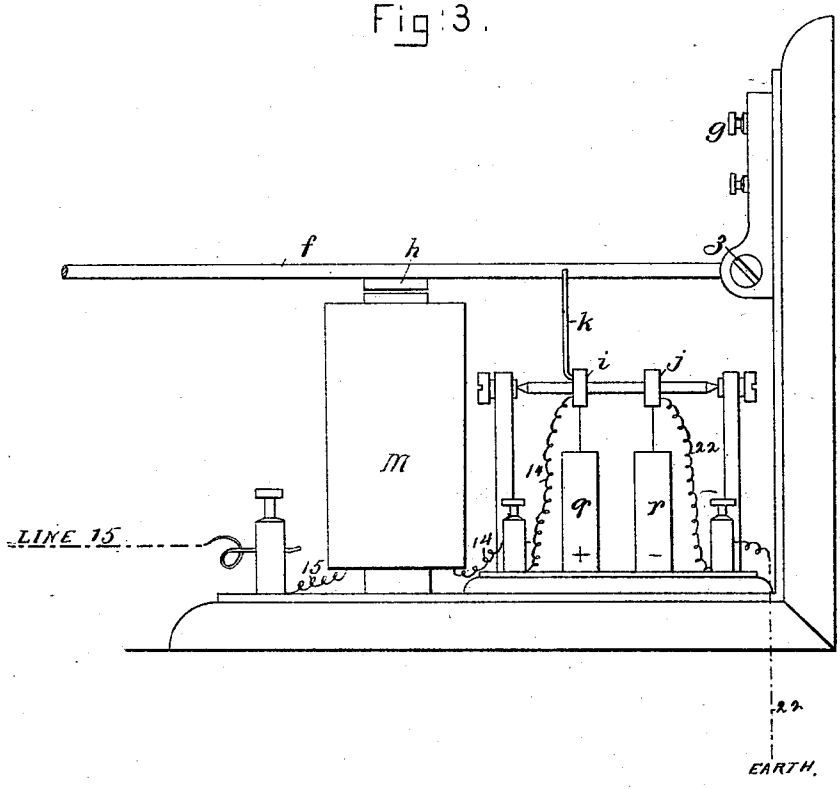
Fig. 3.



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UNITED STATES PATENT OFFICE.

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RAILWAY SIGNAL APPARATUS.

SPECIFICATION forming part of Letters Patent No. 273,517, dated March 6, 1883.

Application filed May 1, 1882. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HADDEN, of Brooklyn, Kings county, State of New York, have invented an Improvement in Railway Signal Apparatus, of which the following description, in connection with the accompanying drawings, is a specification.

My invention relates to a railway signal apparatus of that class in which the signals are normally retained in the "safety" position by the attraction of an electro-magnet, and moved to the "danger" position by the action of gravity or other retracting force when the said magnet is demagnetized, as by a circuit-breaker operated by a train entering the block-section guarded by the signal, the said circuit-breaker being normally closed except while the train is acting upon it.

The present invention consists in the combination, with the signal-actuating magnet, of an electric switch or relay operated by the opening of the circuit when the train passes, as just described, to introduce resistance in the line, and thus reduce the power of the signal-actuating magnet, so that it will not be able to move the signal back to its "safety" position after the train has ceased to act on the circuit-breaker, the signal being thus permitted to remain in the "danger" position while the train traverses the section. As herein shown, the electric switch employed for thus introducing the resistance is the armature of a polarized relay, it being held by the normal current, when the signal is at "safety," in the position to close a direct circuit not containing the resistance; and the invention further consists in the combination, with the signal-actuating electro-magnet, or other magnet in circuit therewith, of a pole-changing device operated by the armature thereof to reverse the polarity of the current when the said armature is retracted, the said reversed current acting upon the polarized relay to cause it to introduce the resistance, and thus prevent the attraction of the armature by which the pole-changing device was operated.

The invention further consists in the combination, with the signal-actuating magnet and the electric switch in circuit therewith and resistance controlled by the said switch, of an independent branch circuit between the said resistance and the actuating-magnet, with its battery, and a circuit-closer in the said branch circuit, by which the said battery is caused to act on a magnet without the resistance, and consequently with sufficient power to attract the armature, thus restoring all parts to their normal condition.

Figure 1 is a diagram illustrating this invention; Fig. 2, a detail showing the pole-changing device employed on a larger scale; and Fig. 3, a front elevation of the signal-actuating magnet and lever and the pole-changing device and their circuit-connections on a larger scale than in Fig. 1.

The signal apparatus S comprises the signal *a*, consisting of the usual colored banner or disk supported on an arm, *b*, pivoted at 2 in a fulcrum-piece, *c*, adjustably connected with the frame-work by the screw or clamp *d*, the said arm *b* being connected by a link, *e*, with an armature-lever, *f*, pivoted at 3 in an adjustable pivot-piece, *g*, mounted on frame-work. The said lever *f* carries the armature *h* of the signal-actuating magnet M, and is overbalanced by the weight of the signal *a*, which thus operates as a retractor for the armature *h*, removing it from the poles of the magnet when the latter is demagnetized. The said armature-lever *f*, in its movements to and from the poles of its magnet, operates a pole-changing device to reverse the connection of the poles of the battery with the line external thereto. The said pole-changing device consists in this instance of two levers, *i j*, pivoted to move simultaneously, the said levers being composed of electrically-conductive material, insulated from one another, and connected with the two ends of the main-line circuit that are to be thereby connected with the poles of the battery or source of electrical energy. The said levers *i j* are connected by a link, *k*, with the armature-lever *f*, so as to be rocked from the full to the dotted line position, Fig. 2, as the armature *h* is retracted from the poles of the magnet. The said levers *i j* are provided with contact-points *l m* and *n o*, respectively, at their opposite ends, those at one pair of adjacent ends of the two levers, as *m o*, being adapted to dip into mercury in

the cups *p r* when the levers *i j* are in their normal position, shown in full lines, Fig. 2, the signal being at "safety," and the ones *l n* at the other ends of the said levers dipping into the mercury in the cups *q s* when the said levers are in the dotted-line position, Fig. 2, and the signal *a* at "danger," one of the said pairs of contact-points being removed from the mercury in the corresponding cups just after the other pair enters it in the other pair of cups. The cups *p r* are connected with the opposite poles of the battery—for example, the former with the positive and the latter with the negative pole—so that when the levers *i j* are in their full-line or normal position the lever *i* and end of the line connected therewith receives the positive, and the lever *j* and other end of the line connected therewith receives the negative electricity from the battery. The cups *q s*, at the other end of the levers *i j*, are respectively connected with the opposite poles of the battery to the ones *p r*, so that when the levers *i j* are in the dotted-line position they will be in electrical connection with the opposite poles, respectively, to what they were when in the full-line position, and the current will traverse the line in the opposite direction.

The main circuit is as follows: Starting from one pole of the main battery B (as, for example, the one marked +,) it passes by wires 12 13 to the mercury in the cups *p* and *s*, and when the signal is in its normal or safety position the latter is insulated, and the circuit is continued from the former cup, *p*, to the lever *i*, and thence by wire 14 to the magnet M, and thence by wire 15, which constitutes the main line, to the other end of the section, where it passes through the coils of a polarized relay, R, from which it is continued by a wire, 16, to the armature-lever *t* of the said relay, and by a wire, 17, to the resistance-coils *u*, and thence to the ground at E′. The armature-lever *t* of the relay R has a contact-point connected with a wire, 18, leading to the ground at E′, so that when the said armature is in the position shown in full lines the current has a direct path from the main-line wire 15 through the wire 16, armature *t*, and wire 18, to the ground, and is not weakened by being obliged to traverse the resistance *u*. This is the normal position of the armature of the relay R under the action of the current which traverses the line when the pole-changer, operated by the armature-lever *f*, is in its normal position, the signal *a* being at "safety." The other pole of the battery B is connected by wires 20 21 with the cups *r q*, respectively, and when the levers *i j* are in the normal position the said pole of the battery connected with the cup *r* has its circuit continued through the contact-piece *o* and lever *j* to the line-wire 22 on the opposite side from the line-wire 15, the said wire 22 being connected with the ground E, from which the circuit is completed through the ground to E′; or, if desired, a wire may be employed, instead of the ground-connections at E E′, when a wholly metallic circuit is desired.

As herein shown, the apparatus is arranged to operate in connection with a single-track railway over which trains pass in both directions. Another signal apparatus, S′, similar to the one already described, with the omission of the pole-changing device, is placed at the other end of the section, its actuating-magnet M′ being included in the line-wire 15, and it will be seen that as many actuating-magnets as may be desired may be included in the said line-wire, the entire series of signals being operated simultaneously by the changes in condition in the said circuit.

The main-line circuit is provided near either end of the section with circuit-breakers b' b^2, which are normally closed, but are opened by the train entering the section from either end, they being of any convenient construction, numerous instruments for this purpose having been heretofore used. When one of the said circuit-breakers is opened—as by the entrance of a train into the section—the magnets M M′ are demagnetized and the signals drop by the action of gravity into the "danger" position. In this movement the position of the pole-changer is changed to that shown in dotted lines, Fig. 2, the negative pole of the battery being now connected by the wire 21, contact-piece *l*, and lever *i* with the line 15, and the positive pole being connected by the wire 13, contact-piece *n*, and lever *j* with the wire 22, so that the current now traverses the line in the opposite direction to that in which it did before the circuit-breaker was opened, thus causing a movement of the armature *t* of the polarized relay R out of contact with the conductor 18, so that the current is now compelled to pass by wire 17 through the resistance *u*, and is so weakened by the said resistance as to be insufficient, in acting on the magnets M M′, to move their armatures and restore the signals to "safety" position after the circuit is closed by the passage of the train beyond the circuit-closer b' or b^2. The signals are restored to their "safety" position by means of branch circuits between the battery B, with the magnet M, by which the pole-changer is operated, and the resistance *u*.

In the arrangement shown for single track there are two of these branch circuits, 25 and 26, one at each end of the section, connecting the line-wire 15 at a point between the resistance *u* on one side and the battery B, with the magnet M, by which the pole-changer is actnated, on the other side, with the earth at E^2 or E′, or with the wire 22 or 17, forming the circuit to the other pole of the battery. The said wires 25 and 26 are provided with normally-open circuit-closers c' c^2, located so as to be operated after the corresponding circuit-breakers, b' b^2, at the same end of the section by a train leaving the section, but before the circuit-breakers by a train entering the section.

In operation, when a train enters the sec-

tion with the signals in their normal or "safety" position, it will first operate one of the circuit-closers, as c', producing no effect on the signals, and after it has passed the said circuit-closer it will open the circuit-breaker b', setting the signals to "danger," as before described, they being thereafter retained in the "danger" position by the interposition of the resistance u in the circuit while the train traverses the section, and in passing off it will first operate the circuit-breaker b^2, producing no effect on the signals, and then, in its further movement, it will close the circuit-closer c^2, thus completing the circuit from E by wires 22 and 13, battery B, wires 21 and 14, magnet M, and wires 15 and 26, to the ground at E', so that the battery acts upon the said magnet M with its full power, attracting the armature thereof, restoring the signal to the "safety" position and restoring the pole-changer to its normal position, so that the current is reversed, and the small portion of it which passes through the coils of the relay R, wire 17, and resistance u is sufficient to restore the armature t of the said relay to its normal position in connection with the wire 18, thus removing the resistance u from the circuit, or, more properly speaking, providing an additional circuit without the said resistance, so that the battery acts with its full force to retain the signal in its safety position. It may be that the relay R will not be affected by the portion of current passing through branch 17 u while the branch 26 is closed; but the moment the latter is opened the said relay will be affected, closing the branch 18 before the armature of the magnet M is moved sufficiently to again reverse the pole-changer.

When desired the signals can be operated otherwise than by the passage of the train by other circuit-controlling instruments operated by hand or operatively connected with the mechanism by which the rails of a switch or the bolt or other movable portion of a drawbridge is operated. Such a circuit-controlling instrument is shown at d', it consisting of an electric switch forming a portion of the main-line circuit, it being connected at one end with the wire 15, and removable to and from an anvil, e', connected with the other portion of the wire 15. When it is moved off from the said anvil e', as shown in dotted lines, it opens the circuit, and thus demagnetizes the signal-operating magnets and permits the signals to be moved to the "danger" position; but it does not necessarily affect the relay R or introduce the resistance u into the line, as it is not necessary to close the circuit until it is desired to restore the signals to "safety."

In closing the circuit it is necessary that the pole-changer should be restored to its normal position before the current passes through the relay R, in order to prevent the latter from introducing the resistance u. This is accomplished by means of the anvil-piece f', connected by wire 27 with the ground E^3, or return-wire between the wires 22 and 17, if one be employed, so that in the return movement of the electric switch d' from its dotted to its full line position, Fig. 1, it will close a circuit including the battery B and magnet M before it arrives at the anvil e' and closes the main circuit, and consequently the pole-changer will be restored to its normal position before the main line is closed and the relay R affected by the current therethrough.

It is obvious that a separate magnet included in the main circuit might be employed to control the movement of the pole-changer, instead of employing the magnets by which one of the signals is actuated, it being necessary only that the armature by which the pole-changer is operated should remain retracted when the line is open or the resistance u is included therein and attracted at other times.

It is also true that the pole-changer may be omitted and the relay R itself operated by the opening of the circuit and closure of a branch circuit, such arrangement not being, however, herein specifically illustrated or claimed, as it will form the subject of a separate application.

The relay R, herein shown, may have retractive force applied to its armature t, tending to remove it from connection with the wire 18 when the circuit is opened, the said armature being retained in such position by the reversal of the current caused by the pole-changer, and restored to the position in connection with the said wire by the normal current, which should be sufficient to overcome the said retractor, even when acting through the resistance u.

When a hand-operated circuit-closer, as the one d', is employed, there will usually be a signal apparatus used in connection with it, as at S^2, it being operated by a magnet in the main circuit to indicate the condition of the section. Such a signal may be of small size, as it is not to be viewed by the engineer of a passing train.

When the apparatus is to be used on a double-track railway, where the trains pass over each track in one direction only—as from the signal S toward the relay R in Fig. 1—the branch 25, with its circuit-closer c', may be omitted, as well as the circuit-breaker b^2 at the other end of the section, the signal S' being retained or omitted, as may be deemed expedient.

I claim—

1. In a railway signal apparatus, the signal-actuating magnet in a normally-closed circuit, combined with a circuit-breaker and relay or circuit-changing magnet in the said circuit, and resistance interposed and retained therein by the said relay when the said circuit is broken and subsequently closed, substantially as and for the purpose described.

2. The signal-operating electro-magnet and relay, combined with branch circuits from the said signal-operating magnet of different resistance, closed respectively by the armature of the said relay when in its different positions, substantially as described.

3. The signal-actuating magnet, the relay, and the resistance interposed in the circuit of the said magnet by the said relay, combined with an independent circuit and closer, including the said signal-actuating magnet and battery without the said resistance, substantially as and for the purpose set forth.

4. The electro-magnet and pole-changer controlled by it, combined with the polarized relay and resistance controlled by it in accordance with the condition of the said pole-changer and its controlling-magnet, substantially as described.

5. The electro-magnet and pole-changer controlled thereby, and the polarized relay controlled by the said pole-changer, combined with resistance interposed by the said relay when the pole changer is reversed by the demagnetization of its controlling-magnet, and an independent branch circuit and circuit-closer between the said magnet, with its battery, and the resistance whereby the magnet is caused to attract its armature, and thus cause the pole-changer and polarized relay to be restored to their normal condition and the resistance removed from the circuit, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM HADDEN.

Witnesses:

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W. H. SIGSTON.