No. 761,848. PATENTED JUNE 7, 1904.

C. H. MORSE.

TROLLEY SIGNAL.

APPLICATION FILED JUNE 27, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

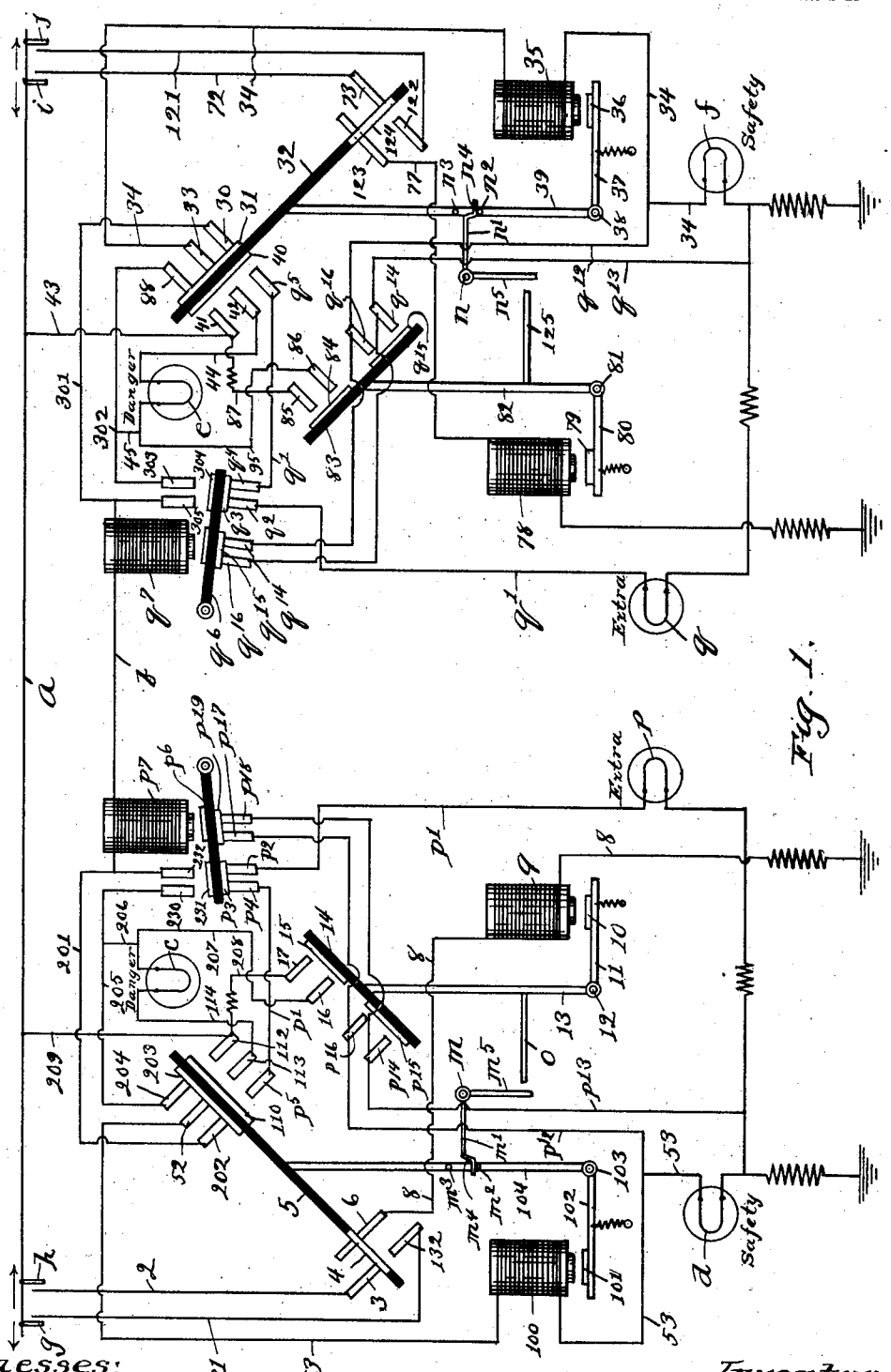


Fig. 1.

Witnesses:
H. B. Dare
J. W. Decrow.

Inventor:
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by B. J. Fahy & Co. Atty

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

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NO MODEL. 3 SHEETS—SHEET 2.

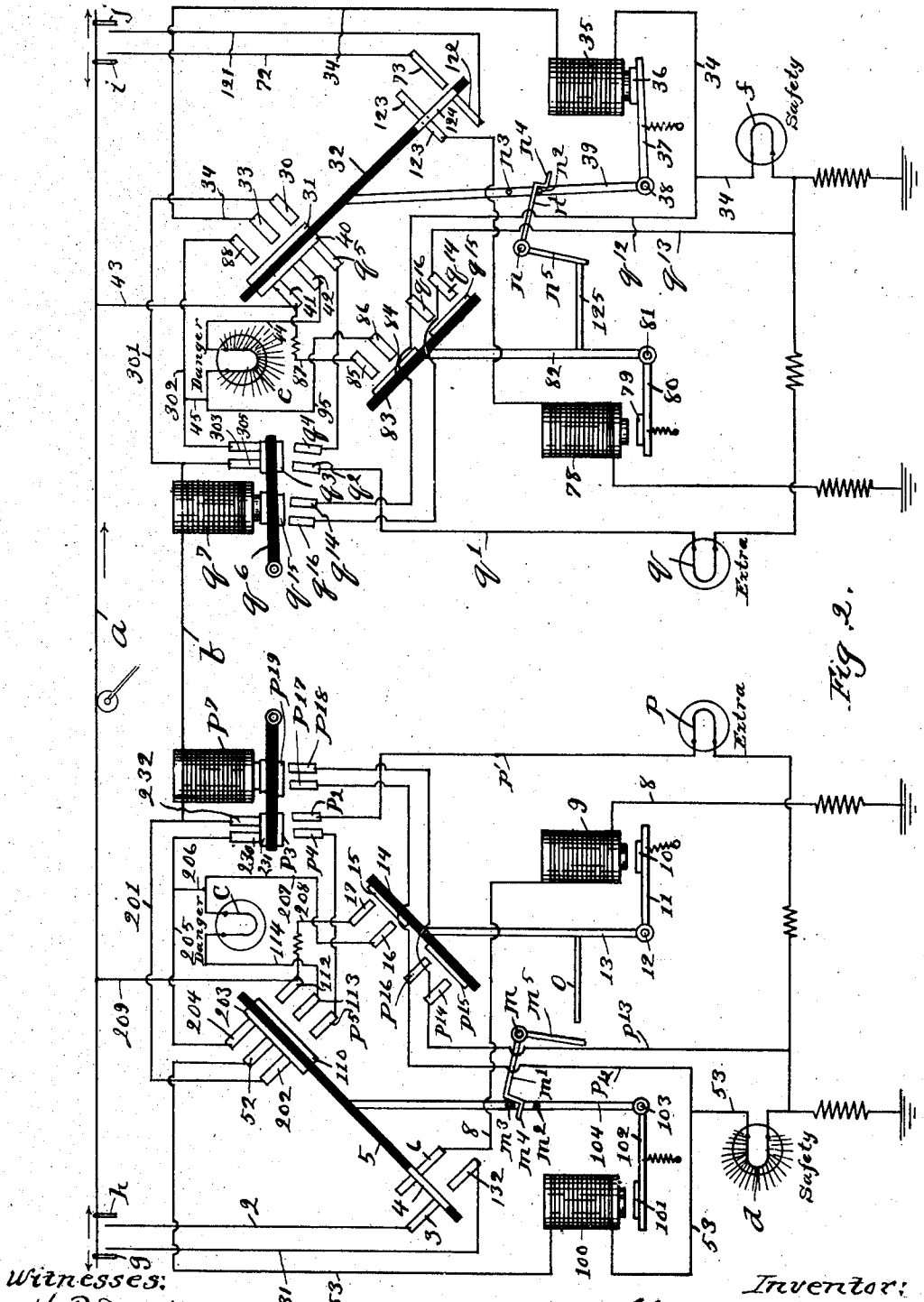


Fig. 2.

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

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NO MODEL. 3 SHEETS—SHEET 3.

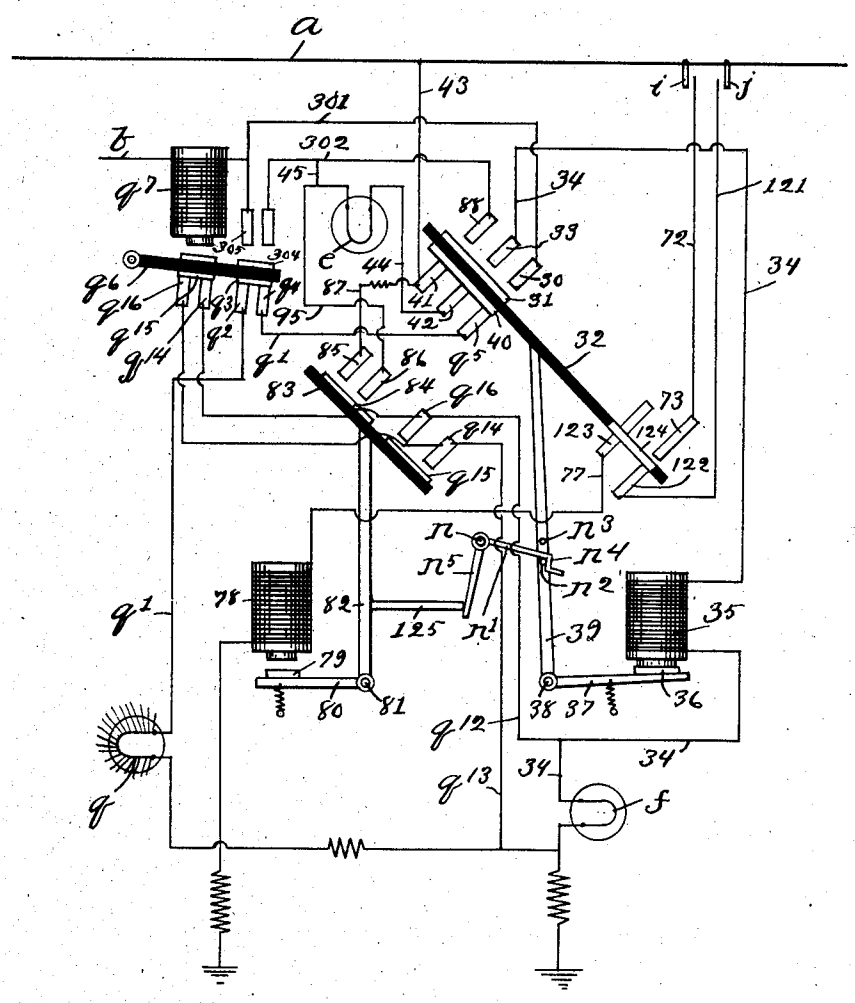


Fig. 3.

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No. 761,848. Patented June 7, 1904.

UNITED STATES PATENT OFFICE.

CHARLES H. MORSE, OF CAMBRIDGE, MASSACHUSETTS.

TROLLEY-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 761,848, dated June 7, 1904.

Application filed June 27, 1901. Serial No. 66,235. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. MORSE, of Cambridge, county of Middlesex, State of Massachusetts, have invented an Improvement in Trolley-Signals, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention has for its object to improve the construction of trolley-signals, and is intended as an improvement on the trolley-signal shown and described in my Letters Patent No. 678,894, dated July 23, 1901. In my said patent the trolley-signal comprises, essentially, a danger-signal and a safety-signal at each end of a block and means for setting the safety-signal at one end of the block and which for clearness will be referred to as the "entering" end of the block and for setting the danger-signal at the opposite end of the block and which for clearness will be referred to as the "leaving" end thereof when a car enters the block and for putting out said signals when the car leaves the block. The signals shown in said application are incandescent lamps; and objection is sometimes made to their use on account of their liability of burning out.

In accordance with this invention an auxiliary danger-signal is provided at each end of the block and automatic means provided for setting the auxiliary danger-signal at the leaving end of the block in case the signal-circuit becomes inoperative while the main or regular signals are set—as, for instance, by burning out of either signal-lamp or by the cessation of the current on the signal-circuit or by a break of the signal-circuit.

Also in accordance with this invention means are provided at each end of the block whereby the safety-signal thereat will be short-circuited while the signal apparatus is being operated to set the danger-signal at the leaving end of the block, so that in case either or both safety signal-lamps should be burned out the danger-signal at the leaving end of the block may still be set.

Also in accordance with this invention means are provided at each end of the block whereby the auxiliary danger-signal can be "set" at the leaving end of the block in case either or both safety signal-lamps and either or both main or regular danger-signal lamps should be burned out when the signal apparatus is operated at either end of the block.

Figure 1 represents in diagram a trolley-signal embodying this invention, the parts thereof being shown in their normal position of rest. Fig. 2 is a similar diagram showing the parts in the position they will occupy when a car is on the block and moving in the direction of the arrow, the left-hand end of the block being at such time the entering end and the right-hand end of the block the leaving end; and Fig. 3 is a similar diagram of the apparatus at the leaving end of the block, showing the parts in the position they will occupy when the main danger-signal-lamp has been burned out or the signal-circuit has for any other cause become inoperative while a car is on the block and the auxiliary signal set.

a represents a trolley-wire, or it may be any other current-carrying wire, and *b* is a signal-wire. At each end of a block or section of signal-wire *b* two visual signals are provided, which are herein shown as red lamps *c* and *e* and blue lamps *d f*, the red lamps or signals indicating danger and the blue lamps or signals indicating safety, and said lamps *c e d f* serve as and constitute the main or regular signals. Also at each end of the block two contacts are provided adapted to be operated by the trolley, as *g h i j*, the trolley-contacts *h* and *i* being constructed and arranged to be operated by a car entering the block and the trolley-contacts *g j* being constructed and arranged to be operated by a car leaving the block. The trolley-contact *h* is connected with the trolley-wire *a* and when operated by a car engages a contact which is connected by a wire 2 with a contact-pen 3, normally bearing upon a metallic plate 4, borne by a bar 5 of insulating material or other form of frame, and a contact-pen 6 also bears on said plate 4, which is connected by a wire 8 to the ground or other return through a suitable resistance, and a relay 9 is included in said grounded wire 8, the armature 10 of

which is carried by an arm 11, pivoted at 12. When the trolley-contact *h* is closed, the ground branch 2 3 4 6 8 will be closed provided the switch 3 4 6 is closed. An arm 13 is formed rigidly with the arm 11, which projects upward and bears at its upper end a bar 14 of insulating material, to which a metallic plate 15 is secured, which when moved by the attracted armature 10 is adapted to engage a pair of contact-pens 16 17 and close a connection between the signal-wire *b* and trolley-wire *a*, said connection being represented by wire 201, leading from the signal-wire *b* to a contact-pen 202, bearing on the plate 203, contact-pen 204, also bearing on said plate, wires 205 206 207, contact-pen 16, plate 14, contact-pen 17, wires 208 and 209 to the trolley-wire *a*. Thus when the entering trolley-contact *h* is closed the current from the trolley-wire passes through the relay 9 to the ground, and as the armature of said relay is attracted a connection is closed between the signal-wire and the trolley-wire at the entering end of the block, providing the switches 3 4 6 and 202 203 204 are closed. As the entering trolley-contact *h* is only closed for a short interval of time by the trolley, these two circuits will only be closed momentarily; yet said circuits will be held closed long enough for the current from the trolley-wire to pass to and along the signal-wire *b* and operate certain devices at the entering end of the block and also certain devices at the opposite or leaving end of the block, as will be described.

At each end of the block a normally closed ground branch wire leads from the signal-wire and at the entering end of the block 53 represents said ground branch wire, it including the switch 202 203 52, (normally closed,) an electromagnet 100, the safety lamp or signal *d*, and a suitable resistance. At the opposite or leaving end of the block, 34 represents the normally closed ground branch wire, it including a switch 30 31 33, the electromagnet 35, the safety lamp or signal *f*, and a suitable resistance. The armature 101 of the electromagnet 100 is borne by an arm 102, pivoted at 103, and rigidly secured to said arm 102 is an arm 104, to the upper end of which the bar 5 is secured, which carries the metallic plates 4 and 203. At the opposite or leaving end of the block the signal-wire *b* is connected by wire 301 to the contact-pen 30 of a switch, which normally bears upon a metallic plate 31, borne by a bar 32 of insulating material or other form of frame, and a contact-pen 33 also normally rests on said plate 31, and the ground branch wire 34 leads from said contact-pen 33 to the ground, including the electromagnet 35, the armature 36 of which is borne by an arm 37, pivoted at 38, and rigidly secured to said arm 37 is an arm 39, to the upper end of which the bar 32 of insulating material is secured. As the current momentarily passes from the trolley-wire through the connection 209 208 17 15 16 207 206 205 204 203 202 201 to the signal-wire *b* at the entering end of the block, the electromagnet 100 at said entering end of the block will be energized; but its armature will be prevented from attracting by means of a locking device to be described which has been previously operated by the relay 9, and the electromagnet 35 at the opposite or leaving end of the block will also be energized, its armature 36 attracted, and the bar 32 moved, so that the plate 31 will disengage the contact-pens 30 33, and thereby open the ground branch wire 34, and when said bar 32 is thus moved a metallic plate 40, borne by it, will engage a pair of contact-pens 41 42 and close a connection between the trolley-wire *a* and signal-wire *b*, herein shown as wires 43 44 45 302 and switch 303 304 305, operated by the magnet q^7 to be described, and also when said bar 32 is thus moved by the magnet 35 its arm 39 will be moved into engagement with a locking device to be described, to be held by said locking device, as the electromagnet 35 is immediately deënergized. As soon as this connection is established the current from the trolley-wire *a* will pass over the wires 43 44 45 302 to the signal-wire *b* and thence along the signal-wire *b* to the entering end of the block and thence to the contact-pen 202, metallic plate 203, contact-pen 52, wire 53 to the ground or other return.

The red lamp *e* at the leaving end of the block is included in the wire 44 between the trolley-wire and signal-wire, and the blue lamp *d* at the opposite or entering end of the block is included in the ground wire 53, and it will be seen from the foregoing description that when the trolley-engaging contact *h* is operated by a trolley entering the block the danger-signal *e* will be set at the leaving end of of the block by closing the connection between the trolley-wire and signal-wire thereat, and the safety-signal *d* will be set at the entering end of the block, as it is included in the ground connection of the signal-wire. The relay 9 and switch 15 16 17 serve as a signal-operating device, and the magnet 35 and switch 40 41 42, operated by it, serve as the signal-setting device. The signals *e* and *d* will at such time be connected in series, the signal *e* in the connecting-wire between the trolley-wire and signal-wire and the signal *d* in the ground branch wire leading from the signal-wire.

When the connection between the trolley-wire *a* and signal-wire *b* was established by closing the switch 40 41 42, the ground branch wire 34, including the signal-setting magnet 35, was opened by opening the switch 30 31 33, and consequently the signal-wire containing the two signals *e* and *d* in series has but a single closed ground branch 53, and to hold said switch 40 41 42 closed with the signals *e* and *d* thus set when the switch 30 31 33 is opened, and the signal-setting magnet 35 consequently de-

energized, a locking device is provided, which, as herein shown, consists of a bell-crank lever pivoted at n, one arm, as n', of which is adapted to coöperate with pins n^2 n^3, projecting laterally from the upright arm 39, carrying the bar 32.

Normally the arm n' rests by gravity on the pin n^2; but when said arm 39 is moved by the attraction of the armature 36 the pin n^2 is moved along beneath said arm n' beyond a shoulder or bend n^4, formed in said arm, and when so moved said arm n' will fall by gravity into the full-line position shown in Fig. 2, and thereby positively lock the arm 39 in its abnormal position, holding the armature 36 in its attracted position notwithstanding the electromagnet is or is about to become deënergized and also holding the switch 40 41 42 closed. The switch 40 41 42 will thus be held closed by the locking device n' until said locking device has been restored to its normal position, which is accomplished by the operation of the leaving trolley-contact j, operated by the car when leaving the block, as will be described. When the signals e and d are thus set, it is also necessary that the switch 202 203 52 shall be held closed and also that the bar 5, to which the plate 203 of said switch is attached, shall remain in its normal position, so as to prevent "setting" the danger-signal at the entering end of the block notwithstanding the electromagnet 100, which operates said bar 5, is included in said closed ground tap or branch 53. To accomplish this result, a locking device is also provided at the entering end of the block, which is constructed substantially the same as the locking device at the opposite end of the block, it consisting, essentially, of a bell-crank lever pivoted at m, one arm, as m', of which is adapted to coöperate with suitable pins m^2 m^3, projecting laterally from the upright arm 104, carrying the bar 5, which is rigidly secured to the arm 102, bearing the armature 101 of the electromagnet 100, which is included in the ground branch wire or tap 53, and is consequently energized when the switch 202 203 52 is closed and the signals e and d set, as above described. Normally the arm m' rests by gravity on the pin m^2, and when in such position the other arm m^5 of said bell-crank lever occupies a position in the path of movement of an arm o, projecting laterally from the upright arm 13, and when the armature 10 of the relay 9 is attracted and the arm 13 moved to close the switch 15 16 17 the arm o will strike the arm m^5 and lift the arm m' into the full-line position shown in Fig. 2, so that its shoulder or bend m^4 will occupy a position opposite and close to the pin m^3, and the arm 104 will be thereby mechanically held. It will be remembered that the relay 9 was operated by the trolley-contact h, and consequently operated before the electromagnet 100 was energized. Therefore it will be seen that the locking device m' m^5 will be moved by the relay 9 into position to prevent movement of the arm 104 notwithstanding the electromagnet 100 is subsequently energized. The electromagnet 100 is, however, energized immediately after the locking device m' m^5 is moved and by pulling upon its armature 101 will cause the pin m^3 to bear hard against the shoulder or bend m^4 of said locking device and hold said locking device in its abnormal position even though the armature 10 of the relay 9 retracts. Thus the switch 202 203 52 will be held closed by the locking device m' m^5 when the signals e and d are set.

When the car enters the block at the left, Fig. 1, the trolley-contact h is operated, the ground branch wire 2 3 4 6 8 is closed, the relay or signal operating magnet 9 energized, the switch 15 16 17 closed, and electrical connection established between the trolley-wire and signal-wire at the entering end of the block as follows: 209, 208, 17, 15, 16, 207, 206, 205, 204, 203, 202, 201 to b, and the ground branch circuit 53 at the entering end of the block will also be closed and take current from the trolley-wire as follows: 203, 52, 53, energizing the signal-setting magnet 100 and lighting the main safety-signal d, which is included directly in said ground branch wire; but said signal-setting magnet 100, although energized, is incapable of performing any result, as the signal-setting switches operated by it are prevented from operation by the locking device, which latter was operated by the signal-operating magnet 9, and the ground branch wire 34 at the opposite end of the block, which is normally closed and which includes the signal-setting magnet 35, takes current from the signal-wire b as follows: 301, 30, 31, 33, 34 to ground, and said signal-setting magnet 35 is energized and the magnets p^7 and q^7 also energized. The switch 230 231 232 is closed by the magnet p^7, and switch 303 304 305 is closed by the magnet q^7, and the switch 40 41 42 is closed by the magnet 35, and the switch 30 31 32 is opened by said signal-setting magnet 35, and the arm 39 is locked, and the signal-circuit is thus established. The signal-operating magnet 9 is deënergized by the opening of the trolley-contact h. The signal-circuit which is thus established is as follows: 43, 41, 40, 42, 44, danger-signal e, 45, 302, 303, 304, 305, b, 201, 202, 203, 52, 53, including the main safety-signal d. Fig. 2 represents the parts in the above position.

When the car arrives at the leaving end of the block, its trolley engages and operates the trolley-contact j to restore the set signals e and d to their normal condition and also restore both of the locking devices n' n^5 and m' m^5 to their normal positions, so that all the parts will resume their normal condition and positions, as represented in Fig. 1.

When the trolley-contact j is closed, as by a car leaving the block, a ground branch wire is closed, including the wires 121, switch 122

123 124, wire 77, and relay 78, the armature of which is adapted to operate the locking device n' n^5 to release the arm 39.

The switch 122 123 124 comprises the contact-pens 122 123 and plate 124, and said plate 124 is carried by the bar 32 and is moved by said bar into engagement with its contacts when said bar is moved to close the switch 40 41 42 and set the signals e and d; yet the closing of said switch 122 123 124 at such time subserves no other end than to place the ground branch 121 77 in condition to be operated by the trolley-contact j and put out the signals.

The armature 79 of the relay 78 is carried by an arm 80, pivoted at 81, and an upright arm 82 is rigidly secured to said arm 80, which has an arm 125, projecting laterally from it, adapted to engage the arm n^5 of the locking device n' n^5.

When the trolley-contact j is closed, the ground branch 121 77 is closed, and the relay 78 energized, and as its armature is attracted the laterally-projecting arm 125 will engage the arm n^5 and by moving it will lift the arm n' free from the pin n^2, permitting the arm 39 to resume its normal position. The locking device n' n^5 is also permitted to resume its normal position. As the arm 39 resumes its normal position the switch 40 41 42 is opened, thereby breaking the connection between the trolley-wire and signal-wire, and the set signals e and d will both be put out or restored to their normal condition, and the switch 30 31 33 will be closed, and also the switch 122 123 124 will be opened. At the opposite or entering end of the block it will be seen that as soon as said switch 40 41 42 is opened the electromagnet 100 will be deënergized and will cease to exert a pull upon its armature, and the pressure of the pin m^3 on the locking device m' being thereby relieved said locking device will resume its normal position. The set signals are therefore both restored to their normal condition, and the locking devices are also both restored to their normal positions.

If instead of the car entering at the left-hand end of the block and operating the trolley-contact h, as above described, it should enter the block at the opposite end, it would engage and operate the trolley-contact i, and when said trolley-contact i is operated the visual signals c and f will be set, and the locking devices n' n^5 and m' m^5 operated in a reverse manner to that previously described.

The trolley-contact i is adapted to be connected with the trolley-wire a and by a wire 72 with a contact-pen 73, normally bearing upon the plate 124, borne by the bar 32, and the contact-pen 123 also normally bears on said plate 124, which is connected to the wire 77, which leads to the ground or other return through a suitable resistance, said ground branch including the relay 78, heretofore referred to. The arm 82, which is connected to the armature-carrying lever 80 of said relay 78, also extends upward and bears a bar 83 of insulating material, carrying a plate 84, adapted to engage the contact-pens 85 86 when said arm 82 is moved by the attraction of the armature 79 of the relay 78. The contact-pen 85 is connected by wire 87 and 43 with the trolley-wire a, and the contact-pen 86 is connected by wires 95 45 302 with a contact-pen 88, normally bearing upon the plate 31, borne by the bar 32, on which the contact-pen 30 also normally bears, and said contact-pen 30 is connected by a wire 301 with the signal-wire. Thus when the switch 88 31 30 is in its normal closed position and the switch 84 85 86 closed a connection is established between the trolley-wire a and signal-wire b whereby the current from the trolley-wire is conveyed to the signal-wire. Now when the trolley-contact i is operated the ground branch 72 73 124 123 77 is closed, the relay 78 energized, its armature attracted, and the switch 84 85 86 closed, and a path for the current established between the trolley-wire and signal-wire as follows: 43, 87, 85, 84, 86, 95, 45, 302, 88, 31, 30, 301. At the opposite end of the block the current will pass over the ground branch wire 53, the switch 202 203 52 being normally closed, and the electromagnet 100, which is included therein, will be energized, its armature attracted, the arm 104, bearing the bar 5, moved, opening the switch 202 203 52 and closing a switch by which a connection is established between the trolley-wire and signal-wire. This switch consists of a plate 110 on the bar 5, which when closed engages the contact-pens 112 113. The contact-pen 113 is connected by a wire 114 with the signal-wire and includes the signal c, and the contact-pen 112 is connected by a wire 209 with the trolley-wire. When the bar 5 is thus moved to close the switch 110 112 113 and open the switch 202 203 52, the pin m^2 on the upright arm 104 will slip along beneath the arm m' of the locking device m' m^5 to a position back of the bend or shoulder m^4, at which time said arm m' will fall by gravity and lock the arm 104, and thereby hold the bar 5 with the switch 110 112 113 closed.

At the entering end of the block (now the right-hand end) when the armature of the relay 78 moves into its attracted position and closes the switch 84 85 86 the arm 125, projecting from the arm 82, engages the arm n^5 and lifts the arm n' into a position opposite the pin n^3 to thereby prevent the arm 39 from being moved by the electromagnet 35 when said magnet is energized, so as to hold the switch 30 31 33 closed and also prevent the signal e being operated at the entering end of the block, and as said switch 30 31 33 is held closed the ground branch wire 34, including the electromagnet 35 and also including the

signal f, will be held closed, and said electromagnet 35, pulling upon its armature, causes the pin n^3 to bear hard upon the arm n', and thereby hold said arm in its elevated position. With the parts in this position the signals c and f will be set, and the circuit will be as follows: 209, 112, 110, 113, 114, signal c, 206, switch 230 231 232, to be described, signal-wire b, switch 305 304 303 302 88 31 33, ground branch wire or tap 34, including the signal f.

When the car which enters the block at the right-hand end and operates the trolley-contact i leaves said block, it will engage and operate the trolley-engaging contact g. The trolley-contact g is connected by a wire 131 with a contact-pen 132, which engages the plate 4, carried by the bar 5, and said plate also engages the contact-pen 6, which is connected by the wire 8 to the ground through a suitable resistance and which includes the relay 9, heretofore described. The switch 132 4 6 is closed when the bar 5 is moved by the operation of the electromagnet 100, which occurs when the car enters the block and operates the trolley-contact i, so that when said car enters the block it sets the switch 132 4 6 in condition, so that the trolley-contact g when operated may restore the set signals c and f to their normal condition and also restore the locking devices m' and n'. When said trolley-contact g is operated by the car leaving the block, the ground branch 131 132 4 6 8 will be closed, the relay 9 operated, the arm o operated by it to engage the arm m^5 and lift the arm m' free from the pin m^2, thereby permitting the arm 104 to resume its normal position, and as said arm 104 resumes its normal position the switch 110 112 113 is opened and the connection between the trolley-wire and signal-wire broken and the signal c put out or restored to its normal condition, and as the connection with the trolley-wire is thus broken the signal f will be put out or restored to its normal condition, and the electromagnet 35 will cease pulling upon its armature and, consequently the pressure of the pin n^3 of the arm n' will be relieved, permitting said arm n' to fall by gravity to its normal position. Thus the set signals c and f will be restored to their normal condition and the locking devices also restored to their normal positions.

At each end of the block an auxiliary signal is provided adapted to be set whenever the main signal at the corresponding end burns out or the signal-wire breaks or there is a temporary cessation of the current on the signal-wire, and, as herein shown, p represents a signal-lamp at one end of the block and q a signal-lamp at the other end of the block, said signal-lamps serving as the auxiliary signals.

The signal-lamp p is included in a branch wire p', one end of which leads to the ground—as, for instance, it may be connected to the ground branch 53—and the other end leads to a switch $p^2\ p^3\ p^4$ and thence to a contact-pen p^5, which is adapted to be engaged by a plate 110 on the bar 5 of the signal-setting device, which is operated by the electromagnet 100. The plate p^3 of the switch $p^2\ p^3\ p^4$ is borne by the armature p^6 of an electromagnet p^7, which is included directly in the signal-circuit, and said switch is closed whenever said armature is in its retracted position, but is opened immediately said armature is attracted. When the current passes over the signal-wire—as, for instance, when setting the signal—the armature is attracted and the branch wire containing the auxiliary signal-lamp opened at $p^2\ p^3\ p^4$; yet if the main signal-lamp c is set at the left-hand end of the block the signal-setting device will have been operated by the electromagnet 100 and the plate 110 will engage the contact-pen p^5, and thus connect the branch wire p' with the signal-wires.

The auxiliary signal-lamp p will not glow, because its circuit is open at $p^2\ p^3\ p^4$; but if the main signal-lamp c should burn out the armature of the electromagnet p^7 will immediately retract and operate to close the branch wire p' at $p^2\ p^3\ p^4$, and as said branch wire will be at such time closed at p^5 110 the current will pass from the trolley-wire, as follows: 209, 112, 110, p^5, p', closed switch $p^2\ p^3\ p^4$, signal-lamp p to the ground. At the opposite end of the block the signal-lamp q is included in a branch wire q', one end of which leads to the ground—as, for instance, it may be connected to the branch wire 34—and the other end leads to a switch $q^2\ q^3\ q^4$ and thence to a contact-pen q^5, which is adapted to be engaged by a plate 40 on the bar 32 of the signal-setting device.

The plate q^3 of the switch $q^2\ q^3\ q^4$ is borne by the armature q^6 of an electromagnet q^7, which is included directly in the signal-circuit, and said switch is closed whenever said armature is in its retracted position, but is opened immediately said armature is attracted. When the current passes over the signal-wire—as, for instance, when setting the signal—the armature is attracted and the branch wire containing the auxiliary signal-lamp opened at $q^2\ q^3\ q^4$; yet if the signal-lamp e is set at the right-hand end of the block the signal-setting device will have been operated by the electromagnet 35, and the plate 40 will engage the contact-pen q^5, and thus connect the branch wire q' with the signal-wire. The auxiliary signal-lamp q will not glow, because its circuit is opened at $q^2\ q^3\ q^4$; but if the signal-lamp e should be burned out the armature of the electromagnet q^7 will immediately attract and operate to close the branch wire q' at $q^2\ q^3\ q^4$, and as said branch wire is at such time closed at g^5 40 the current will pass from the trolley-wire, as follows: 43, 40, q^5, q', closed switch $q^2\ q^3\ q^4$, lamp q to the ground. Thus it will be seen that while the main signal is set at either end of the block if it should burn out the

auxiliary signal-lamp at the corresponding end of the block will be immediately included in the circuit. Also it will be seen that whenever the safety or danger signals are set at opposite ends of the block, being included in the same live circuit, if either lamp should burn out the auxiliary signal-lamp at the end showing the danger-signal will be immediately included in the circuit, and in case of a cessation of the current or a break in the signal-wire the auxiliary signal at the danger end of the block will be included in the circuit.

The auxiliary signal-lamps will be restored or reset by the restoring or resetting of the signal-setting device just as if the main signals were in operation, as previously described.

In case the safety signal-lamp, as d or f, should be burned out whenever the signal apparatus is operated by a car entering the block, whereupon it would be impossible to set the danger-signal at the remote or leaving end of the block, because no path for the current could be established, I have herein provided a short circuit for each safety signal-lamp adapted to be operated by the signal-operating device to obviate this difficulty.

p^{12} p^{13} represent a pair of wires leading from the wire 53 at opposite sides on the safety signal-lamp d, which include the switch p^{14} p^{15} p^{16}, the plate p^{15} of which is borne by a bar 14 of the signal-operating device, so that whenever the electromagnet 9 is energized said switch p^{14} p^{15} p^{16} will be closed, thereby shunting out the signal-lamp d temporarily and providing a path for the current while setting the danger-signal at the opposite or leaving end of the block. The wires p^{12} p^{13} when closed by the switch p^{14} p^{15} p^{16} will form a part of the branch 53 at such time.

q^{12} q^{13} represent a pair of wires leading from the wire 34 at the opposite sides of the safety signal-lamp f or d, including the switch q^{14} q^{15} q^{16}, the plate q^{15} of which is borne by a bar 83 of the signal-operating device, so that whenever the electromagnet 78 is energized said switch q^{14} q^{15} q^{16} will be closed, thereby shunting out the signal-lamp f temporarily and providing a path for the current while setting the danger-signal at the opposite or leaving end of the block. The wires q^{12} q^{13} when closed by the switch q^{14} q^{15} q^{16} will form a part of the branch 34 at such time.

In case either or both safety signal-lamp or either or both danger-signal lamp should burn out at the same time and to set the danger-signal at the leaving end of the block it becomes necessary to at once utilize the auxiliary signal as the danger-signal, and I have provided means for accomplishing this result. At the left-hand end of the block a pair of wires p^{12} p^{13} are extended beyond the switch p^{14} p^{15} p^{16} to a switch p^{17} p^{18} p^{19}, the plate p^{19} of which is borne by the armature p^6 of the electromagnet p^7. Whenever said armature is in its retracted position, said switch p^{17} p^{18} p^{19} will be closed, thereby establishing a path for the current to the ground around the safety signal-lamp d. At the opposite or right-hand end of the block a pair of wires q^{12} q^{13} are extended beyond the switch q^{14} q^{15} q^{16} to a switch q^{17} q^{18} q^{19}, the plate q^{19} of which is borne by the armature q^6 of the electromagnet q^7, and whenever said armature is in its retracted position said switch q^{17} q^{18} q^{19} will be closed, thereby establishing a path for the current to ground around the safety signal-lamp m.

I claim—

1. In a trolley-signal, a main danger-signal at each end of a block, a signal-operating device at each end of the block, a signal-setting device at each end of the block for setting the main danger-signal at the same end of the block, said signal-setting devices being operated by the signal-operating devices at the opposite ends of the block, an auxiliary signal at each end of the block, the circuits of which are controlled by the signal-setting devices at the same ends of the block, and an operating device for the auxiliary signal at each end of the block controlled by the signal-circuit, and adapted to operate while the signal-setting device at the same end of the block is set, and circuits for said signals, substantially as described.

2. In a trolley-signal, a main danger-signal at each end of a block, a signal-operating device at each end of the block, a signal-setting device at each end of the block for setting the main danger-signal at the same end of the block, said signal-setting devices being operated by the signal-operating devices at the opposite ends of the block, an auxiliary signal at each end of the block, the circuits of which are controlled by the signal-setting devices at the same ends of the block, and an operating device for the auxiliary signal at each end of the block controlled by the signal-circuit and adapted to operate while the signal-setting device at the same end of the block is set, and means at each end of the block for restoring the set signals, and circuits for said signals, substantially as described.

3. In a trolley-signal, two different main signals at each end of a block, a signal-operating device at each end of the block, a signal-setting device at each end of the block for setting one of the signals at each end of the block operated by the signal-operating device at the opposite end of the block, an auxiliary signal at each end of the block, the circuits of which are controlled by the signal-setting devices at the same ends of the block, and an operating device for the auxiliary signal at each end of the block controlled by the signal-circuit, adapted to operate while the signal-setting device at the same end of the block is set, and circuits for said signals, substantially as described.

4. In a trolley-signal, the combination of a trolley-wire, a block or section of signal-wire,

a main danger-signal at each end of said block, means operated at either end of the block for setting the main danger-signal at the opposite end of the block, an auxiliary signal also at each end of the block, and automatic means controlled by the signal-circuit for setting the auxiliary signal at the leaving end of the block, substantially as described.

5. In a trolley-signal, the combination of a trolley-wire, a block or section of signal-wire, a main danger-signal at each end of said block, means operated at either end of the block for setting the main danger-signal at the opposite end of the block, an auxiliary signal also at each end of the block, automatic means controlled by the signal-circuit for setting the auxiliary signal at the leaving end of the block, and means at each end of the block for restoring the "set" signal at the leaving end of the block, substantially as described.

6. In a trolley-signal, a main danger-signal at each end of a block, a signal-operating device at each end of the block, a signal-setting device at each end of the block for setting the main danger-signal at the same end of the block operated by the signal-operating device at the opposite end of the block, an auxiliary signal at each end of the block, the circuits of which are operated by the signal-setting devices at the same ends of the block, and an operating device for the auxiliary signal at each end of the block controlled by the signal-circuit and which operates conjunctively with the signal-setting device at the same end of the block to set said auxiliary signal, and circuits for said signals, and means at each end of the block for restoring either the main danger-signal or auxiliary signal which may be set at the leaving end of the block, substantially as described.

7. In a trolley-signal, a trolley-wire, a block or section of signal-wire, a signal at each end of said block, a locking device for each signal which when in one position holds the signal set and when in another position prevents operation of the signal, means at each end of said block for setting the signal at the opposite or leaving end of the block and for operating the locking device to lock it set and for also operating the locking device at the entering end of the block to prevent the operation of the signal thereat, an auxiliary signal at each end of the block and automatic means controlled by the signal-circuit for setting the auxiliary signal at the leaving end of the block, substantially as described.

8. In a trolley-signal, two different signals at each end of a block, a signal-operating device at each end of the block, a signal-setting device at each end of the block for setting one of the signals at each end of the block operated by the signal-operating device at the opposite end of the block, an auxiliary signal at each end of the block and an operating device for it at each end of the block controlled by the signal-circuit which operates while the signal-setting device at the same end of the block is set, circuits for said signals, and means at each end of the block for restoring the main signal or auxiliary signal which may be set and also for restoring both locking devices, substantially as described.

9. In a trolley-signal, the combination of a trolley-wire, a block or section of signal-wire, a main danger-signal at each end of the block, means operated at either end of the block for setting the main danger-signal at the opposite end of the block, an auxiliary signal also at each end of the block, an electromagnet in the signal-circuit at each end of the block and means operated by its retracting-armature for setting the auxiliary signal at the adjacent end of the block, substantially as described.

10. In a trolley-signal, the combination of a trolley-wire, a block or section of signal-wire, a main danger-signal at each end of the block, means operated at either end of the block for setting the main danger-signal at the opposite end of the block, an auxiliary signal also at each end of the block included in a normally open branch wire, an electromagnet in the signal-circuit at each end of the block and a switch operated by its retracting-armature for closing said normally open branch wire and thereby setting the auxiliary signal at the adjacent end of the block, substantially as described,

11. In a trolley-signal, a trolley-wire, a block or section of signal-wire, two different signals at each end of the block, a locking device at each end of the block for one of said signals, which when in one position holds the signal set and when in another position prevents operation of the signal, means at each end of the block, for setting one of the signals at the same end of the block and for operating the locking device to prevent the operation of the other signal, and for setting one of the signals at the opposite end of the block and for operating the locking device to lock it set, and an auxiliary signal at each end of the block and automatic means controlled by the signal-circuit for setting the auxiliary signal at the leaving end of the block, substantially as described.

12. In a trolley-signal, a trolley-wire, a block or section of signal-wire, a signal at each end of said block, a locking device for each signal which when in one position holds the signal set and when in another position prevents operation of the signal, means at each end of said block for setting the signal at the opposite or leaving end of the block and for operating the locking device to lock it set and for also operating the locking device at the entering end of the block to prevent the operation of the signal thereat, an auxiliary signal at each end of the block and automatic means controlled by the signal-circuit for setting the auxiliary signal at the leaving end of the block, and means at each

end of the block for restoring the main signal or auxiliary signal which may be set at the leaving end of the block, and also for restoring both locking devices, substantially as described.

13. In a trolley-signal, the combination of a trolley-wire, a block or section of signal-wire, two different signals at each end of the block, means operated at either end of the block for setting one of the signals at each end of the block, an auxiliary signal also at each end of the block, and automatic means controlled by the signal-circuit for setting the auxiliary signal at the leaving end of the block, substantially as described.

14. In a trolley-signal, two different visual signals at each end of the block, means operated at either end of the block for setting one of the signals at each end of the block, a short circuit at each end of the block for one of the signals thereat, and means for closing said short circuit operated by the means at the same end of the block for setting the signals and circuits for said signals, substantially as described.

15. In a trolley-signal, two different visual signals at each end of a block, a locking device at each end of the block for one of said signals, which when in one position holds the signal set and when in another position prevents the operation of the signal, means at each end of the block for setting one of said signals at the corresponding end of the block and for operating the locking device to prevent the operation of the other signal, and for setting one of the signals at the opposite end of the block and for operating the locking device to lock it set, a short circuit at each end of the block for one of the signals thereat and means for closing it operated by the means employed for setting the signals, and circuits for said signals, substantially as described.

16. In a trolley-signal, two different visual signals at each end of a block, a locking device at each end of the block for one of said signals, which when in one position holds the signal set and when in another position prevents the operation of the signal, means at each end of the block for setting one of said signals at the corresponding end of the block and for operating the locking device to prevent the operation of the other signal and for setting one of the signals at the opposite end of the block and for operating the locking device to lock it set, a short circuit at each end of the block for one of the signals thereat and means for closing it operated by the means employed for setting the signals, means at each end of the block for restoring the set signals and for restoring the locking devices, and circuits for said signals, substantially as described.

17. In a trolley-signal, a trolley-wire, a block or section of signal-wire normally disconnected from the trolley-wire, and having a normally open ground branch at each end including a visual signal, a normally open short circuit for said visual signal, another visual signal at each end of said block included in a normally open connecting-wire between the trolley-wire and signal-wire, an electromagnet at each end of the block for closing said connecting-wire between the trolley-wire and signal-wire and thereby setting the visual signal at the corresponding end of the block and for opening the ground branch including the other visual signal, a relay at each end of the block, means for connecting its circuit with the trolley-wire and means operated by the armature of each relay for closing a connection between the trolley-wire and signal-wire and thereby connecting the electromagnet at the opposite end of the block in circuit with the trolley-wire through the signal-wire and also for closing a short circuit for the visual signal at the corresponding end of the block, substantially as described.

18. In a trolley-signal, two different visual signals at each end of a block, means operated at either end of the block for setting one of the signals at each end of the block, a short circuit at each end of the block for one of the signals thereat, two circuit-closers for said short circuit, one operated by means at the same end of the block employed for setting the signals, and the other operated by the retracting-armature of an electromagnet in the signal-circuit, substantially as described.

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

CHARLES H. MORSE.

Witnesses:
B. J. NOYES,
JOHN W. DECROW.