No. 678,135. Patented July 9, 1901.

J. J. RUDDICK.

ELECTRIC SIGNAL.

(No Model.) (Application filed July 30, 1900.)

2 Sheets—Sheet 1.

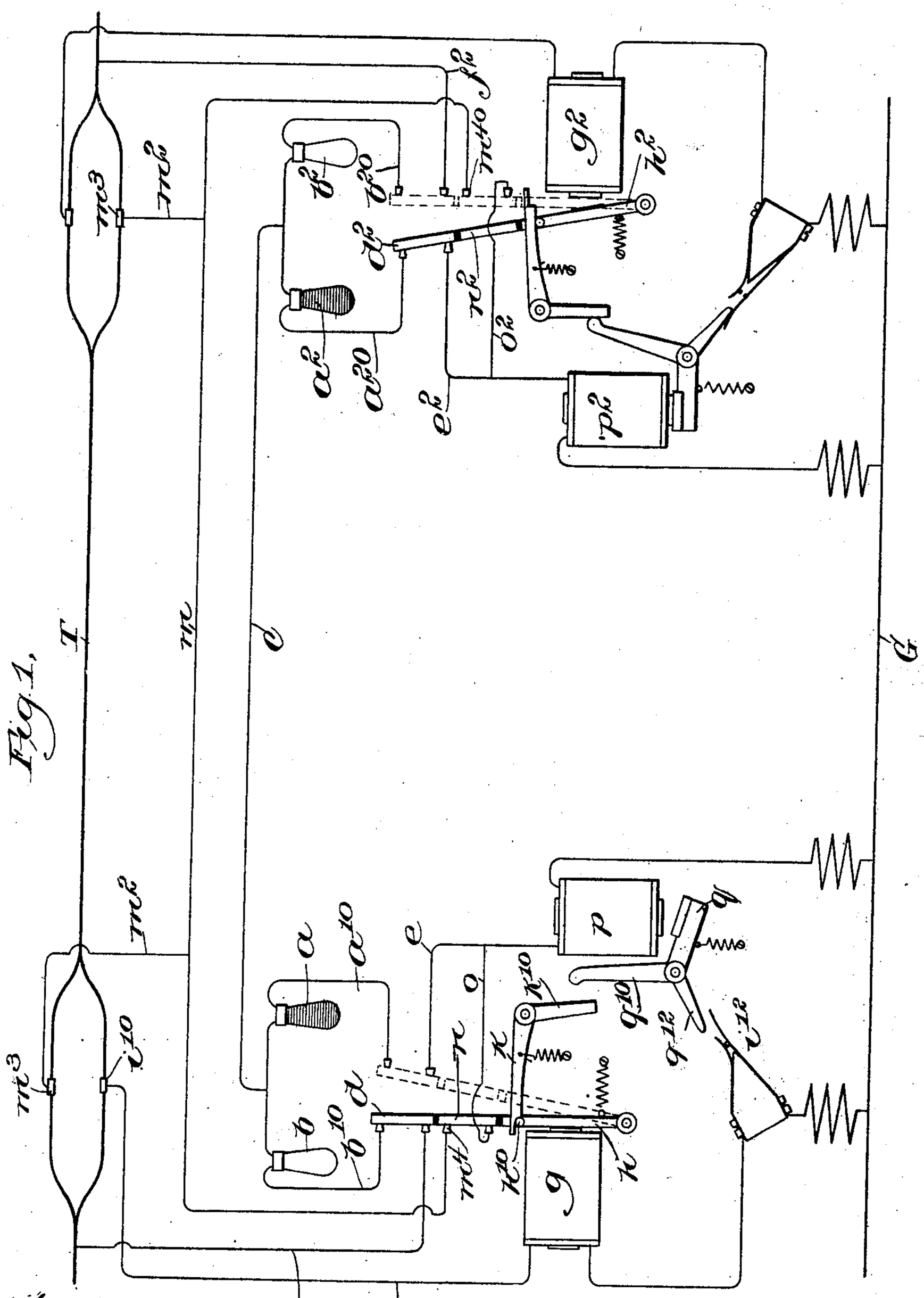

Fig. 1.

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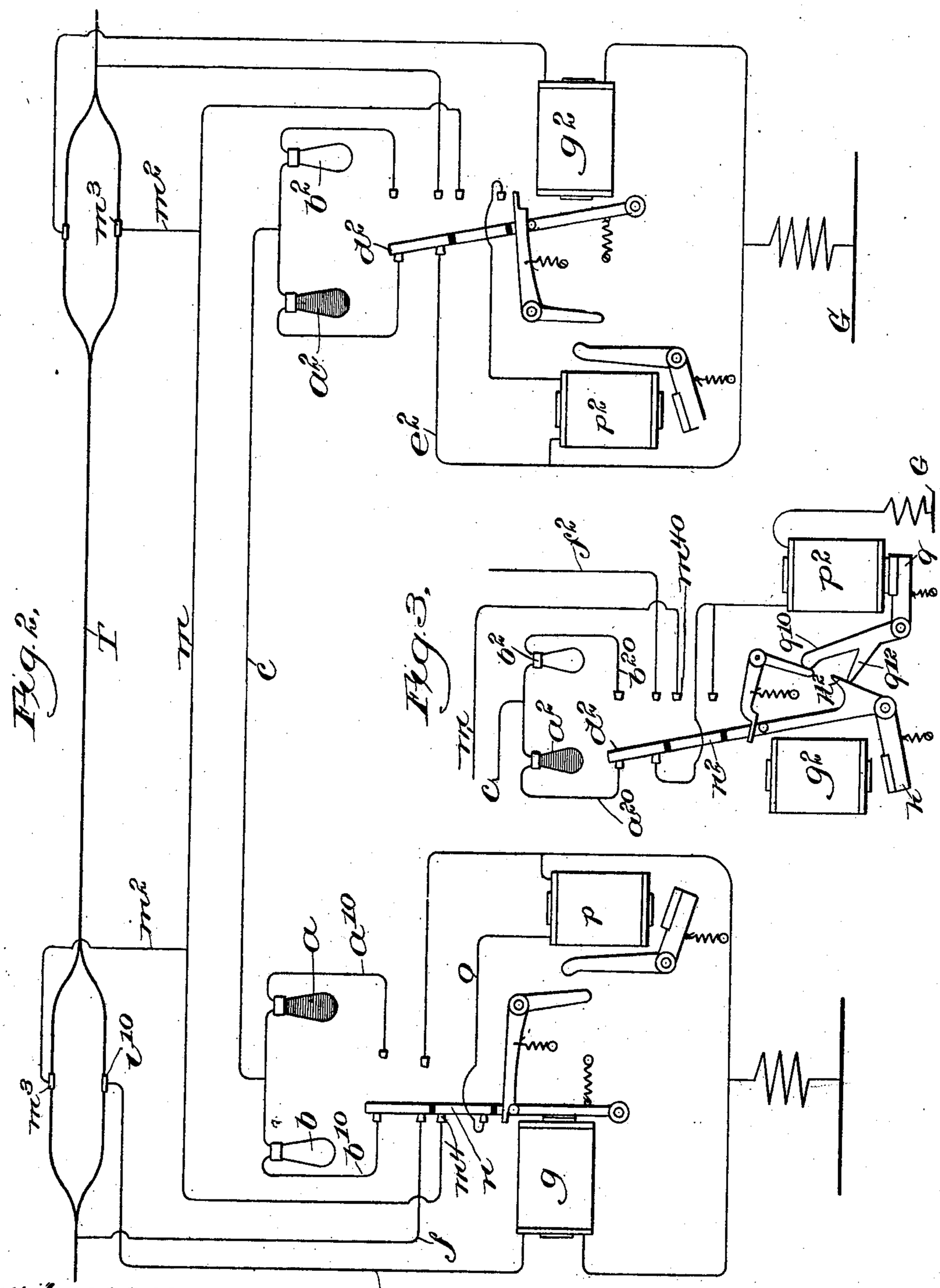

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UNITED STATES PATENT OFFICE.

JOHN J. RUDDICK, OF NEWTON, MASSACHUSETTS.

ELECTRIC SIGNAL.

SPECIFICATION forming part of Letters Patent No. 678,135, dated July 9, 1901.

Application filed July 30, 1900. Serial No. 25,280. (No model.)

To all whom it may concern:

Be it known that I, JOHN J. RUDDICK, of Newton, county of Middlesex, and State of Massachusetts, have invented an Improvement in Electric Signals, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present invention relates to a block-signaling system for railways to guard blocks of single track between turn-outs. The system is of that class in which a car entering the block at either end sets two signals, one at the end where it enters and the other at the remote end, the former to notify the entering car that it has set the danger-signal at the remote end and also to notify a following car that the block is occupied ahead of it by a car going in the same direction and the other to notify a car approaching the remote end that the block is occupied by a car coming toward that end. These signals will be hereinafter referred to for convenience as the "safety-signal" and "danger-signal," respectively. Systems of this class are also arranged so that a car passing out of the block will restore to their normal condition all the signals previously set. The signals may be of any suitable kind, electric lamps being herein shown, and for convenience the signals will be hereinafter referred to as "lights" and the operations of setting and restoring signals referred to, respectively, as "lighting" and "putting out," it being understood, however, that the invention is not limited to any particular form of signal.

The present invention is embodied in a novel system of wiring and means for controlling the signaling-circuit whereby a positive operation of the signals both as to lighting and putting out is assured, a further feature of the invention consisting in novel means for preventing interference of signals if cars enter the opposite ends of the block at substantially the same time.

In accordance with the invention the signals are all contained in one circuit, the said circuit having branches at both ends of the block, one of which contains one of the signals—for example, a red light, or danger-signal—and the other the other signal—for example, a green light, or safety-signal—one branch at one end being adapted to be connected with one conductor of the main circuit, while the other branch at the opposite end is adapted to be connected with the other conductor of the main circuit, the proper connections being made in response to devices which are operated by a car entering the block. The system is shown as applied to an electric railway, in which the current for operating the signals may be taken from the car-operating conductors, and the conductors will be hereinafter referred to as the "trolley-wire" and "ground," with the understanding that the system may be equally well employed with any source of current and that the terms "trolley-wire" and "ground" are used for convenience to designate the two main conductors of any suitable circuit. The putting-out circuit is independent of the signaling-circuit and is provided with connections at each end of the block with the conductors of the main circuit, the putting-out operation being controlled by switches which connect the circuit through the putting-out devices at either or both ends of the block, according to the condition of the signals, the said switches constituting "determining devices," so to speak—that is, devices for determining which signal-restoring device is to be rendered active. The operation of putting out is caused by a mechanical switch operated by the car to send an impulse of current over the circuit, said switch constituting the operating device as distinguished from the determining devices. The signal-setting circuits or lighting-circuits are also independent of the other circuits, each consisting of a conductor leading from a trolley-switch to the ground at one end of the block, and the system is so arranged that if the signals have been set from one end of the block the signal-setting circuit at the opposite end will be broken and kept broken until the signals are restored, so that it is impossible for a car accidentally entering the opposite end of the block to operate upon the signals in any way. The signals when once set in response to the momentary impulse of current in the signal-setting circuit are maintained by an automatic locking device which coöperates with the circuit-controller for the signaling-circuit, and the said locking device is entirely independent of the signal-

setting circuit and can only be unlocked by an impulse of current in the signal-restoring circuit.

Figure 1 is a general diagram of the system embodying the invention, showing a complete block. Fig. 2 is a similar diagram showing the system somewhat modified, the non-interfering arrangements being omitted; and Fig. 3 is a detail showing a modification of the non-interfering mechanism.

While certain important features of the present invention relate to a system in which the same main conductors are used to control signals from both ends of a block and to non-interfering devices for the purpose of preventing confusion in such a system, it is to be understood that there are novel features in the system as applied to a block for operation from one end only, it having been deemed unnecessary, however, to illustrate the system in this way, since in considering the system as operating from one end only it is necessary merely to consider the signaling-circuit as permanently grounded at one end, as if, for example, the bridging-contact d, as shown in dotted lines at the left-hand end of Fig. 1, were a permanent connection, the signal-restoring magnet p at that end being omitted, together with the rest of the mechanism shown.

Referring to Fig. 1, the signals a a^2 and b b^2 are all contained in a signaling-circuit, the main conductor c of which extends from one end of the block to the other. The said main conductor is connected at each end with two branch wires, one of said branches containing the safety and the other the danger signal. The arrangement of the signals at opposite ends of said circuit is substantially the same, the danger-signals a and a^2 and safety-signals b and b^2 at each end being contained in branch conductors a^{10} a^{20} and b^{10} b^{20}, respectively, said conductors having terminals adapted to coöperate with bridging-switches d and d^2. The terminal of the conductor a^{10} is adapted to be connected by said switch d with a conductor e, which passes to the ground, as will be hereinafter described, and the terminal of the conductor b^{10} is adapted to be connected by the said switch d with a conductor f, leading from the trolley-wire T or main feed-wire, as is most convenient. At the opposite end a switch d^2, conductor e^2, and conductor f^2 are similarly arranged. The signals which are in circuit, therefore, depend upon the position of the switches d and d^2, it being obvious that if the branch wire containing the lamp b is connected by the switch d with the conductor f, as shown at the left-hand side of the drawing, the circuit will pass through the said conductor f, the switch d, the lamp b, and conductor c to the opposite end of the block, so that if the switch d^2 is in the position shown at the right-hand end the circuit will be completed through the danger-lamp a^2 and conductor e^2, which leads to the ground G. Such is the condition after a car has entered the block at the left-hand end, the safety-lamp b and the danger-lamp a^2 thus being lighted. If, on the other hand, the switch d^2 is in position to connect the conductor b^{20} with the conductor f^2 and the switch d is in position (shown in dotted lines, Fig. 1) to connect the conductor containing the lamp a with the ground-conductor e, the red or danger light at the left will be lighted and the green or safety light at the right. To produce these conditions in response to the movement of a car, the switches d and d^2 are adapted to be acted upon, respectively, by the signal-setting magnets g and g^2, provided, respectively, with armatures h and h^2, with which are connected the bridging-switches d and d^2.

Referring only to the apparatus at the left of the block and assuming that a car has entered from the left, it will be seen that the electromagnet g will be energized and the armature h will be attracted, connecting the conductor f with the branch conductor b^{10}, containing the lamp b, thereby connecting the circuit containing the said lamp b with the trolley-wire. Since the armature h^2 at the right-hand end of the block is in its normal position—that is to say, unattracted by its magnet—the signaling-circuit will be completed through the wire c, the danger-lamp a^2, switch d^2, and conductor e^2, which leads to the ground. To produce this condition of affairs in response to a car entering the block from the left, the armature h is arranged to be acted upon by the electromagnet g, which is contained in a conductor i, connected at one end with the trolley-wire through a normally open switch i^{10}, adapted to be momentarily closed by the passing car, and at the other end with the ground through a suitable resistance. As the car enters, therefore, the signal-setting circuit represented by the conductor i will be momentarily closed, energizing the magnet g and attracting the armature h. To retain the said armature in its attracted position after the car has entered the block, the said armature is provided with a mechanical locking device k, which is shown as a latch adapted to coöperate with the pin h^{10} on the armature h, so as to lock the said armature in its attracted position, the said latch being held in place by means of a spring. While, therefore, the impulse of current through the magnet g is only momentary, it results in the completion of the signaling-circuit in such a manner as to include the lamp b and the lamp a^2, these conditions remaining the same until the car reaches the opposite end of the block.

To put out the signal-lights, it is necessary to restore the circuits to their normal condition—that is to say, to break the signaling-circuit, (as by the movement of the switch d,) so as to disconnect the feed-wire f from the conductor containing the lamp b. Since there is no current in the magnet g, the switch i^{10} being normally open, it is necessary only to unlock the said armature h, so that it will be restored to its normal position by means of

a retractile spring or otherwise. To accomplish this, the locking device is arranged to be controlled by an impulse of current in an independent signal-restoring or putting-out circuit, which comprises an independent line-wire m, having at each end a normally open connection m^2 with the trolley-wire through a switch m^3, which is adapted to be closed as the car passes out of the block, so as to send a momentary impulse of current into the conductor m, which is grounded at one end or the other of the block, in accordance with the previous condition of the signal-setting circuit. The said conductor m is provided at opposite ends with terminals m^4 and m^{40}, which are adapted to be connected by means of switches n and n^2 with ground-terminals o and o^2, the switches n and n^2 comprising bridging-contacts, which are also carried by the armatures h and h^2, respectively. The said bridging-contacts are insulated from the bridging-contacts d and d^2, so as not to interfere with circuits controlled thereby.

The switches n and n^2 are so arranged as to operate to close their respective ground connections only when the armatures carrying the said switches have been attracted, it being obvious, therefore, that current entering the putting-out wire m will seek the ground at that end of the block where the signals have been previously set by the action of the signal-setting circuit.

The conductors o and o^2, which eventually lead to the ground, pass through the putting-out magnets p and p^2, the armatures of which are arranged to mechanically unlock the armatures h and h^2 when the said armatures are attracted.

Referring to the box at the left-hand end of the sheet, in which the armature h is shown as attracted and locked, it will be seen that the putting-out circuit is completed, when the trolley-switch m^3 has been closed, through the wire m, the contact m^4, the bridging-piece n, the conductor o, and the putting-out magnet p to the ground. The armature q of the putting-out magnet p is therefore attracted and when attracted acts upon the lock through the agency of an arm q^{10}, which coöperates with a tail k^{10} to lift the arm k against the stress of its locking-spring, thereby unlocking the armature h and permitting the same to fall back to its normal position. This at once breaks the signaling-circuit by disconnecting the feed-wire f from the terminal of the conductor c and puts out the lights. By this independent arrangement of the putting-out circuit it is obvious that no matter where the said putting-out circuit is mechanically completed by the movement of a car it will restore the signalling devices to normal at either end of the line, the circuit being completed through the putting-out magnet at the end where the signaling-circuit has been closed. If, however, it is desirable to have the mechanical circuit-closer at one end operate only on the putting-out magnet at the other, it is necessary only to substitute two main conductors for the single main conductor c. The putting-out circuit or circuits are substantially the same as before and wholly independent of the other circuits.

As thus far described it is obvious that if a car were to enter one end of the block after the signals had been set from the opposite end (the motorman disregarding the red lamp, for example, or the said lamp having become burned out) he might operate his own signal-setting device, which would cause a break in the signaling-circuit at his end, thus putting out all the signals along the line and leaving the block unguarded. While he might receive warning that something was wrong by the failure of his own safety-light to operate, it is desirable to render it impossible to break the signaling-circuit except through the operation of the regular putting-out devices. To this end the lighting-circuit at one end is arranged to be broken and kept broken in response to the action of the lighting-magnet at the opposite end, the putting-out magnet at the end where the break occurs being utilized for this purpose. To this end the ground connection at the remote end of the block or end where the danger-signal is displayed is made through the putting-out magnet at that end, so that the armature of the said putting-out magnet is attracted all the time that the signals are lighted, thus opening the circuit through said lighting-magnet—as, for example, by coöperating with a circuit-breaker i^{12} in the lighting-circuit i, one member of said circuit-breaker being operated upon by means of a tail or projection q^{12}, carried by the armature q. When, therefore, the signal is set, the signaling-circuit passes through the feed-wire f, switch d, the conductor b^{10}, signaling-wire c, containing the proper signals, the bridging member d^2, the conductor e^2, and putting-out magnet p^2 to the ground, the armature of the putting-out magnet thus being attracted as long as the signaling-circuit remains intact, the lighting-circuit at the remote end of the block thus being broken, so that a car accidentally entering from that end cannot energize the lighting-magnet and cannot in any way affect the signals.

As indicated in Fig. 3, the armature of the putting-out magnet is adapted to operate mechanically upon the armature of the lighting-magnet, thereby positively preventing the movement of the said latter armature in response to the energization of the lighting-magnet so long as current is flowing through the putting-out magnet. As shown, the arm q^{12} instead of operating a circuit-breaker is adapted to bear against a projection h^{12} or other part of the armature h, thus constituting a stop or prop to prevent said armature from moving even though its magnet is energized. This accomplishes the same result, since it is obviously impossible for the signaling-circuit to be affected except through the movement of the lighting-magnet armature.

The modified system shown in Fig. 2 is substantially the same as that hereinbefore described, except that the non-interfering device is omitted, the putting-out magnet at each end being included only in the putting-out circuit.

In the construction shown in Fig. 2 the lighting-circuit is through the conductor *i* and the lighting-magnet *g* to the ground, the armature of said magnet completing the signaling-circuit, as before, which may be traced through the wire *f*, lamp *b*, conductor *c*, lamp a^2, switch d^2, and wire e^2 directly to the ground around the putting-out magnet. The putting-out circuit passes from the wire m^2 to the main wire *m*, the contact m^4, bridging member *n*, wire *o*, and putting-out magnet *p* to the ground. The system is substantially the same as before, except that it is possible for a car which runs past the lighted danger-lamp to put out all the signals in the block. While of great advantage, however, the non-interfering device is not absolutely essential, since in any event the motorman should not proceed into the block unless he perceives that the safety-signal has been set by his own car operating the mechanical switching device. It is not, therefore, intended to limit the invention to a system including the non-interfering feature, since without this feature the system is novel and useful.

I claim—

1. In a block-signaling system, a signaling-circuit containing signals at each end of the block, said circuit being normally broken; a single circuit-controller therefor initially operated by an electromagnet to set all of the signals in said circuit; means for momentarily energizing said electromagnet; a locking device to maintain the circuit closed after said magnet is deënergized; and a device operated by the car in passing out of the block to unlock said locking device and thereby open the said circuit, as set forth.

2. The combination with two normally open circuits, one at each end of the block, and a signal-setting electromagnet in each of said circuits; of a second circuit extending from one end of the block to the other and having a normally open trolley connection and a normally open ground connection; two signal-restoring electromagnets adapted to be energized by current in said circuit; means operating in response to the action of each signal-setting electromagnet to close the ground connection through the signal-restoring electromagnet corresponding to said signal-setting electromagnet; and a mechanically-operated circuit-closer for said trolley connection, substantially as described.

3. In a block-signaling system, the combination with means for setting the signals; of a signal-restoring device operating in response to current in an independent circuit extending from one end of the block to the other; said circuit; a switch in said circuit adapted to be momentarily closed by a car; a second switch in said circuit; and means for closing said second switch in response to the signal-setting means.

4. In a block-signaling system, the combination with the main circuit; of a signaling-circuit having connections at both ends of the block with the two conductors of the main circuit respectively; switches controlling said connections to determine the signals which are to be set; a signal-setting circuit at each end of the block provided with an electromagnet or equivalent device for operating the switch at that end of the block; a signal-restoring electromagnet at each end of the block; a circuit for said signal-restoring electromagnets extending from one end of the block to the other; a switch in said circuit at each end of the block; means for closing said switch in response to the operation of the signal-setting electromagnet at the end of the block where said switch is located; and a properly-located mechanically-operated switch in the signal-restoring circuit, the switch first named constituting a determining device, and the switch last named constituting the operating device.

5. The combination with the signal-setting devices; of a signal-restoring device at each end of the block; an independent signal-restoring circuit for said signal-restoring devices having connections with the main conductors; two normally open switches in said signal-restoring circuit, one at each end of the block; means operating in response to the action of the signal-setting device at either end of the block to close the switch in the signal-restoring circuit at the same end of the block; and means for sending an impulse of current through the signal-restoring circuit, substantially as described.

6. In a block-signaling system, a signal-setting circuit containing an electromagnet; a mechanically-operated switch in said circuit adapted to be momentarily closed when the car enters the block; an armature for said electromagnet provided with a mechanical locking device to retain it in the position to which it is moved when attracted; a signaling-circuit independent of said signal-setting circuit; means for closing said signaling-circuit in response to the attraction of said armature; an independent signal-restoring circuit having a normally open break; means for closing said break during the time that said armature is in the position to which it is moved when attracted; and a normally open mechanically-operated switch in said signal-restoring circuit adapted to be momentarily closed by the car, substantially as described.

7. In a block-signaling system, the combination with a signaling-circuit normally connected at both ends with one conductor of the main circuit; of means located at each end of the block for breaking the connection with said main conductor and making connection with the other main conductor whereby the signaling-circuit is completed; means located at each end of the block for preventing

the operation of the connecting means aforesaid; and a device for operating said preventing means which depends for its operation upon the connecting means at the opposite end of the block.

8. The combination with the signal-setting circuit at each end of the block; of an electromagnet and its armature in each of said signal-setting circuits; a circuit containing signals and having trolley-wire and ground connections at each end, and switches controlled by the armatures of the electromagnets in the signal-setting circuits, the circuit containing the signals being completed only when one of said armatures is in its normal position, and the other in its abnormal position; a signal-restoring electromagnet at each end of the block; means for connecting said signal-restoring magnet in series with the signaling-circuit, said means depending upon the movement of the armature of the signal-setting magnet to its normal position; an independent signal-restoring circuit; and means for connecting said signal-restoring electromagnet in series with said restoring-circuit in response to the movement of said armature to its abnormal position; and a mechanically-operated switch for closing said signal-restoring circuit at another point, substantially as described.

9. In a block-signaling system, the combination with a signal-setting circuit at each end of the block; of a signaling-circuit having a switch adapted to be closed when the corresponding signal-setting circuit is closed, said signaling-circuit extending to the other end of the block; an electromagnet normally included in said signaling-circuit at the said other end of the block; and means operating in response to the energization of said electromagnet for preventing the closure of the signaling-circuit at the end of the block where said magnet is located, as set forth.

10. The combination with a signal-setting electromagnet; of a circuit containing the said magnet; a signal-restoring electromagnet; a circuit for said signal-restoring electromagnet; a circuit-breaker in the signal-setting electromagnet circuit; means for operating said circuit-breaker in response to the energization of the signal-restoring magnet at the same end of the block; and means operating in response to the setting of the signals at the opposite end of the block for energizing said signal-restoring magnet and maintaining it energized until the signals are restored, as set forth.

11. The combination with the signal-setting circuit containing the circuit-breaker i^{12}; of the electromagnet p; the signaling-circuit c normally closed through said electromagnet p; means located at the opposite end of the block for closing said signaling-circuit to set the signals and energize the magnet p; and the armature q provided with means for breaking the circuit at i^{12} when attracted, substantially as described.

12. In a block-signaling system, a signaling-circuit extending from one end of the block to the other and having at each end two contact-points; a contact-point at each end of the block connected with one of the main conductors; a second contact-point at each end of the block connected with the other main conductor, and an electromagnet 1 in circuit between said second contact-point and said other main conductor; a switch at each end of the block normally standing in a position to connect the signaling-circuit with one of the main conductors through the said electromagnet 1 by bridging the contacts aforesaid; a signal-setting circuit having a circuit-closer operated by the car, and an electromagnet 2 and its armature for moving the said switch to disconnect the signaling device from the conductor through the electromagnet 1 and to connect it with the other main conductor; a signal-restoring circuit adapted to be connected with one of the main conductors by means of a mechanically-operated switch operated by a car; a contact-piece at each end of said signal-restoring circuit; a conductor belonging to the signal-restoring circuit and leading through the electromagnet 1 to the other main conductor and provided with a contact-piece; a switch movable with the switch aforesaid to bridge said contact-pieces and thereby connect the signal-restoring circuit with one conductor of the main circuit through said electromagnet 1, the said electromagnet 1 thus being included in the signaling-circuit or the signal-restoring circuit according to the position of said switch; an armature for said electromagnet 1; a mechanical locking device for the armature of the electromagnet 2; a circuit-breaker in the circuit of electromagnet 2; and means operated by the armature of electromagnet 1 for operating said locking device or said circuit-breaker in accordance with the position of said armature.

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

JOHN J. RUDDICK.

Witnesses:

NANCY P. FORD,

HENRY J. LIVERMORE.