No. 772,665. PATENTED OCT. 18, 1904.

C. H. MORSE & C. F. HOPEWELL.

BLOCK SIGNAL.

APPLICATION FILED MAR. 21, 1904.

NO MODEL. 4 SHEETS—SHEET 1.

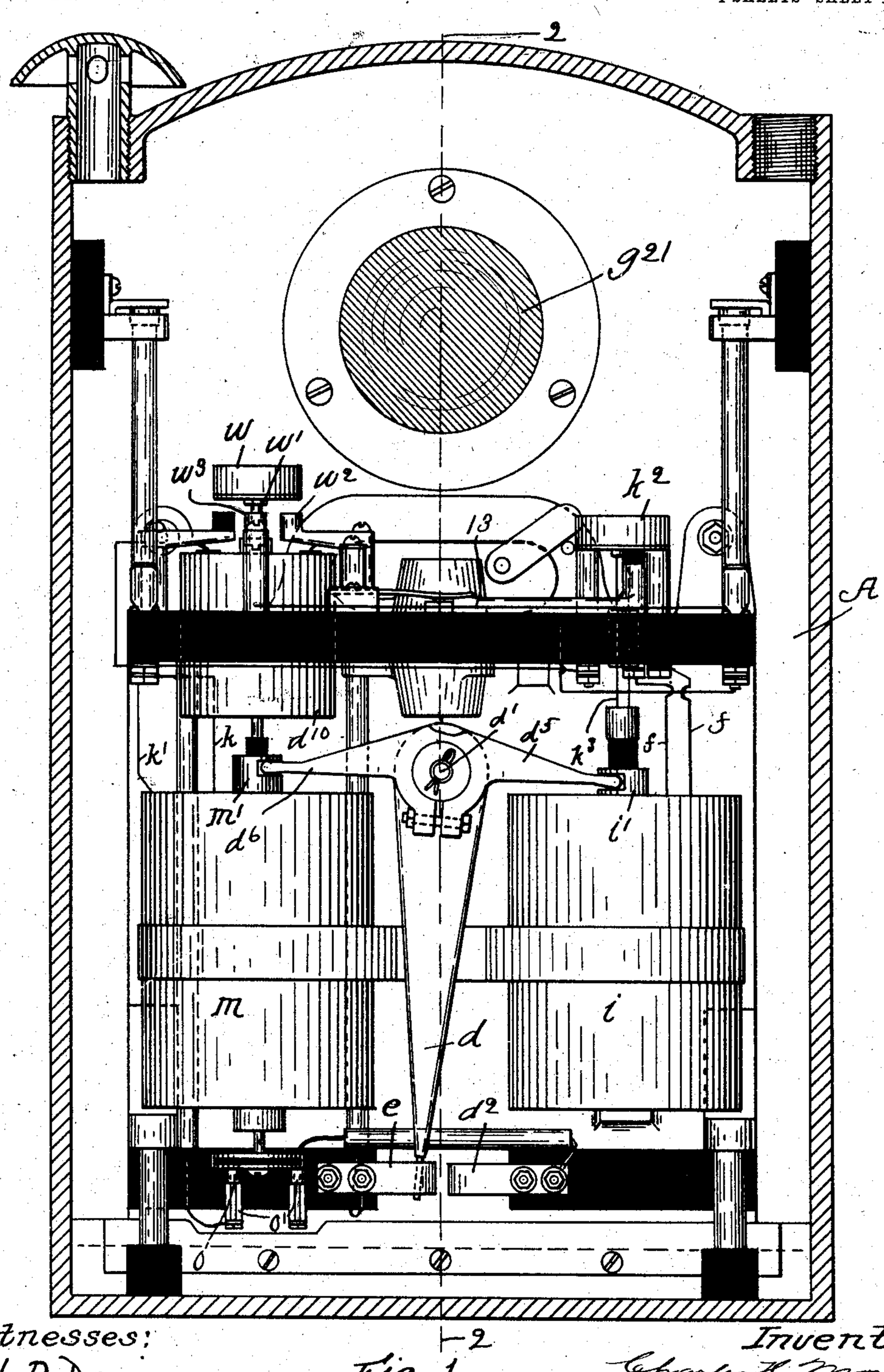

Fig. 1

Witnesses:
H. B. Davis.
Maud M. Piper

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NO MODEL. 4 SHEETS—SHEET 2.

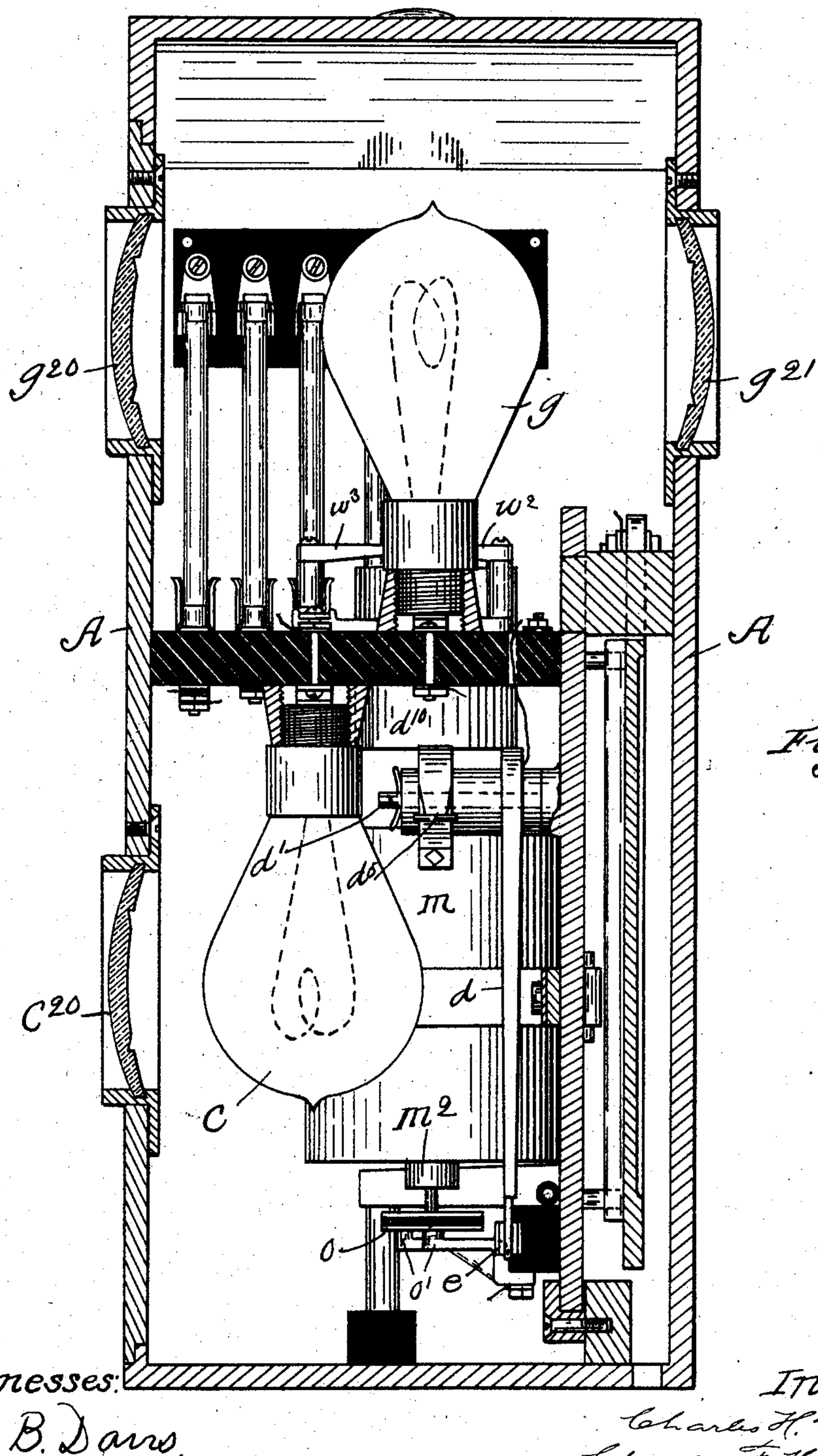

Fig. 2.

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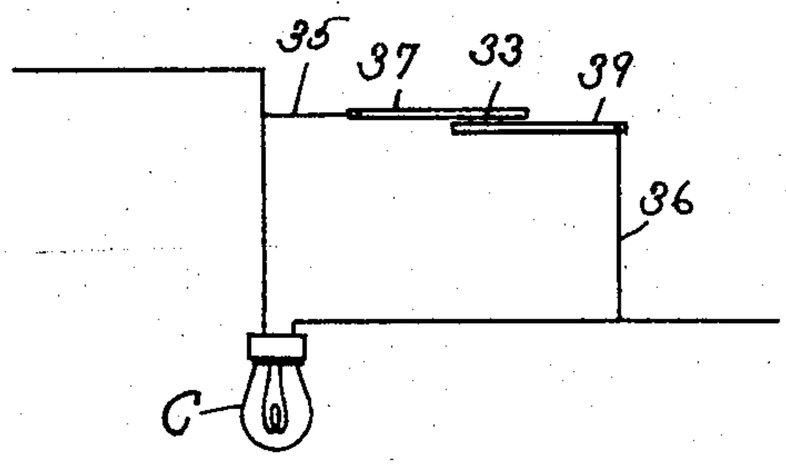
NO MODEL. 4 SHEETS—SHEET 3.



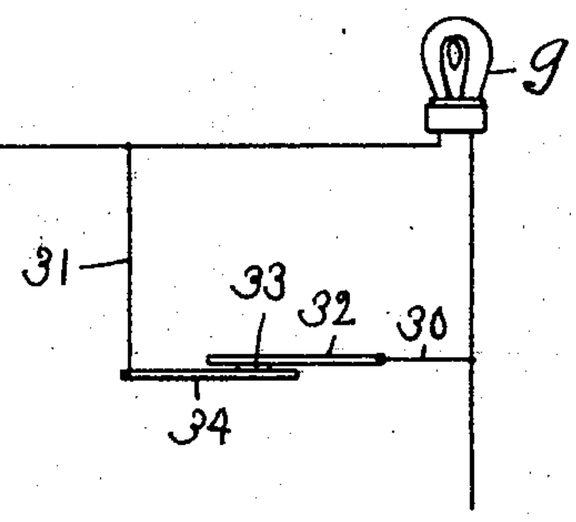


Fig. 3.

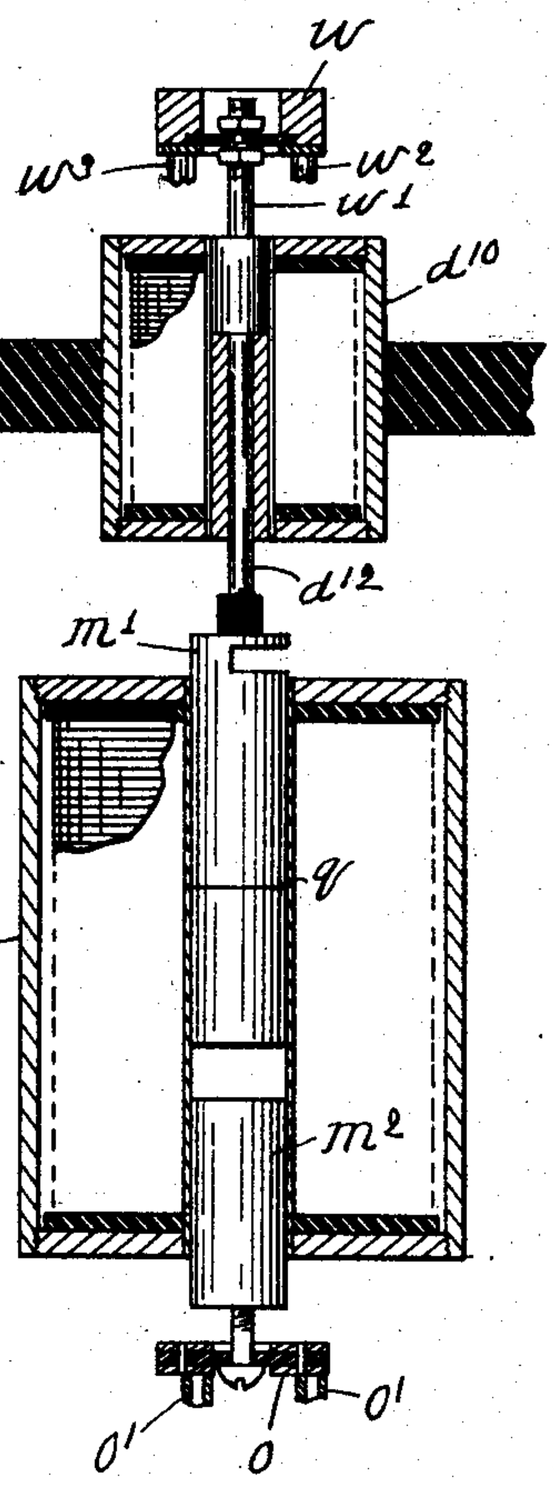


Fig. 4.

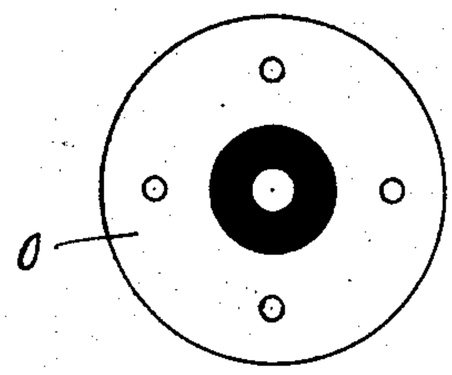


Fig. 5.

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No. 772,665. PATENTED OCT. 18, 1904.

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BLOCK SIGNAL.

APPLICATION FILED MAR. 21, 1904.

NO MODEL. 4 SHEETS—SHEET 4.

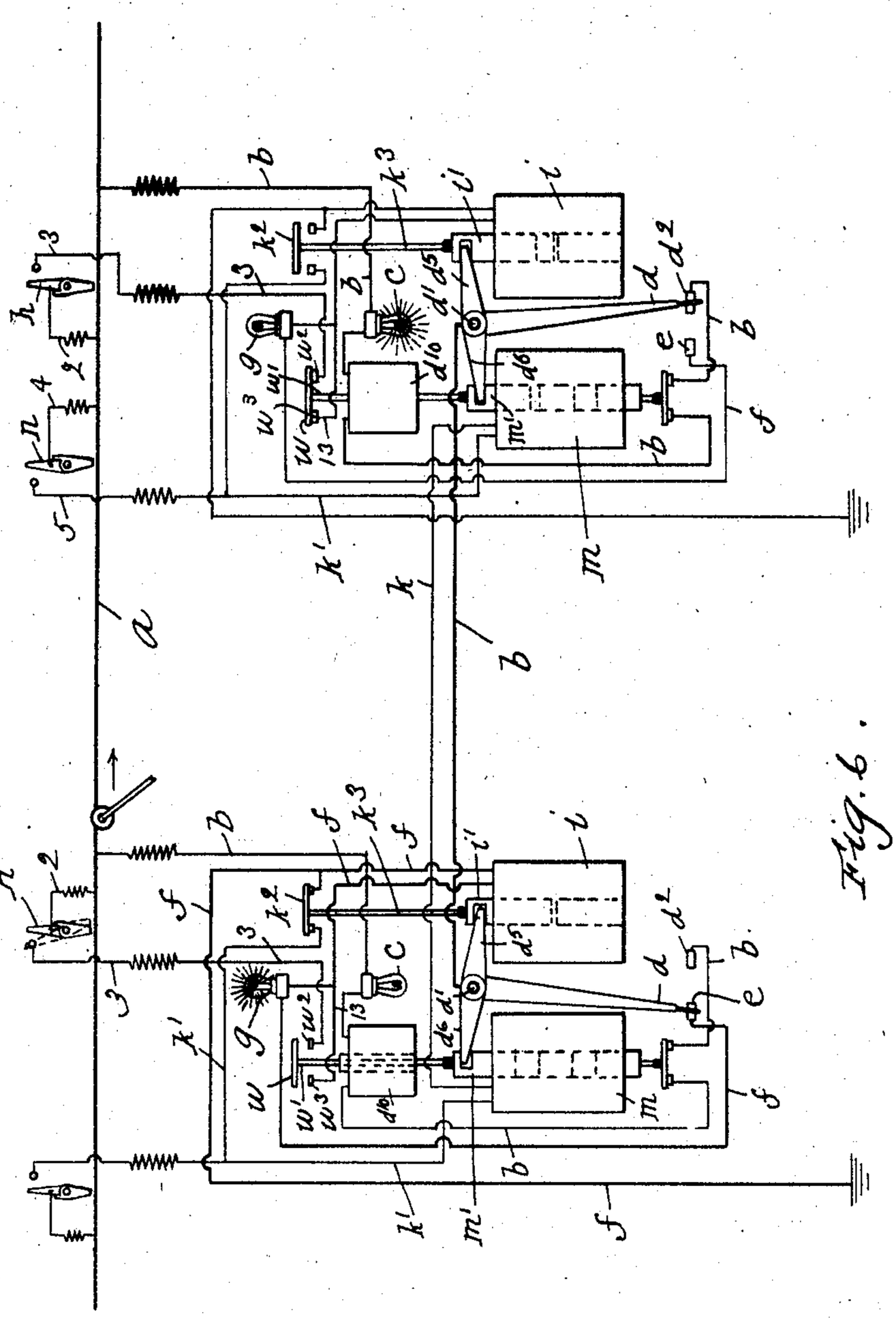

Fig. 6.

Witnesses:

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Charles H. Morse.

Charles F. Hopewell

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No. 772,665. Patented October 18, 1904.

UNITED STATES PATENT OFFICE.

CHARLES H. MORSE AND CHARLES F. HOPEWELL, OF CAMBRIDGE, MASSACHUSETTS.

BLOCK-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 772,665, dated October 18, 1904.

Application filed March 21, 1904. Serial No. 199,158. (No model.)

To all whom it may concern:

Be it known that we, CHARLES H. MORSE and CHARLES F. HOPEWELL, both of Cambridge, county of Middlesex, State of Massachusetts, have invented an Improvement in Block-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 relates to block-signals of the type especially adapted for use as trolley-signals for electric street-railways, and is intended as an improvement upon the block-signal shown in application for Letters Patent, Serial No. 158,236, filed May 22, 1903.

The invention has for its object to provide a normally open ground-terminal at each end of the block for the put-out or extinguishing circuits and to employ a switch at each end of the block for closing the ground-terminal thereat, which is adapted to be operated by the adjacent lighting-magnet, and to arrange the two put-out or extinguishing magnets at the opposite ends of the block in series, this insures all the current passing from the leaving end of the block through both put-out or extinguishing magnets to the ground at the entering end of the block whenever either put-out or extinguishing circuit is operated; also, to provide a locking-magnet at each end of the block, which is designed to be included in the signal-circuit at the leaving end of the block when the signals are set and when energized to positively hold the adjacent signal-controlling switch in its normal position, and thereby prevent it from being operated in case the lighting-circuit at the leaving end of the block should be operated while the signals are set, this is important in case a car should enter the block at the leaving end while the signals are set—that is to say, in case a car should enter the block against a set danger-signal; also, to provide the lighting-circuit at each end of the block with a switch which is normally closed, but which is adapted to be opened by the adjacent signal-controlling switch when the latter is operated to set the signals, thereby immediately opening the lighting-circuit as soon as it has performed its required functions; this is important, as it prevents the momentary glowing of the safety-signals at both ends of the block in case the danger-signal burns out while the signals are set and a car should enter the block at the leaving or danger end while the signals are set, but after the danger-signal has burned out, and also prevents the permanent glowing of both safety-signals in case the trolley-operated circuit-closer should stick in its abnormal position; also, to provide a normally open shunt-circuit around the safety signal-lamp at each end of the block and to include in said shunt-circuit a high-resistance circuit-closer, which is adapted to be operated by the inductive action or "kick" of the lighting-magnet whenever the safety signal-lamp burns out while the signals are set, thereby providing against opening the signal-circuit in case the safety signal-lamp should burn out while the signals are set; the danger signal-lamp in such case will, however, remain lighted; also, to make the lighting-magnets at each end of the block weaker than the put-out magnets, so that the put-out magnets will overpower the lighting-magnets in case it should become necessary for the parts to so operate; this is important in case two cars should enter the opposite ends of the block at the same time and cause both lighting-magnets and both signal-controlling switches to operate, thereby resulting in no signal-lamp glowing and the tying up of the block; but the first car which backs off the block will restore both signal-controlling switches, providing the put-out magnets are strong enough to overpower the lighting-magnets; the put-out magnets are not made strong enough, however, to overpower the lighting-magnets when the signal-circuits are closed and the signals are properly set; also, to provide the box or housing for the safety and danger signal-lamps with lenses, there being two differently-colored lenses placed on opposite sides of the safety signal-lamp or lenses which give different geometrical dispersion to the rays of said lamp.

Figure 1 shows in front elevation a trolley signal-box embodying this invention, the shell

or case of the box being shown in vertical section and the signal-lamps being omitted. Fig. 2 is a vertical section of the trolley signal-box shown in Fig. 1, taken on the dotted line 2 2. Fig. 3 shows in diagram the high-resistance circuit-closers included in shunt-circuits around the signal-lamps. Fig. 4 is a vertical section of the put-out magnet and locking-magnet to be referred to. Fig. 5 is an enlarged detail of a coöperative part of one of the switches. Fig. 6 is a diagram of the circuits and operating parts in the positions they will occupy when the car is on the block and going in a direction toward the right, as represented by the arrow.

a represents the trolley-wire or other current-carrying wire, and *b* the signal-wire, which is permanently connected to the trolley-wire at each end of the block and which passes through a box at each end of the block which contains the visual signals and operating devices therefor. In each box a visual signal *c*, represented as an incandescent lamp, is included directly in the signal-wire *b* and is designed to serve as the danger-signal. In each box a switch is provided, herein called the "signal-controlling" switch, which is adapted to normally hold the signal-wire *b* closed, but which when operated or moved in one direction will open said signal-wire and also connect said signal-wire with a ground-wire, to thereby complete or establish a circuit, which is herein called a "signal-circuit." The signal-circuit when established leads from the trolley-wire *a* or other current-carrying wire at the remote or leaving end of the block to the ground at the opposite or entering end of the block.

The signal-controlling switch consists of an arm or blade *d*, depending from a pivot *d'* and normally occupying approximately a vertical position, and a pair of spring-acting contact-fingers or engaging plates d^2, which receive between them, and thereby engage and hold, the lower end of said arm or blade *d* when the switch-arm is in the position to hold the signal-wire *b* closed, which, it will be understood, is the normal position of said switch-arm. The spring-acting contact-fingers d^2 engage and hold the arm *d* frictionally, so that a little pull is required to disengage said arm. Normally the switch-arms *d* of both boxes will occupy the position shown in the right-hand box, Fig. 6, and consequently the signal-wire *b* will be closed at each end of the block and a signal-circuit is not established. When the switch-arm *d* is moved out of engagement with the contact-fingers d^2, it will be moved into engagement with a pair of like spring-acting contact-fingers *e*, which are connected with a ground-wire *f* to complete or establish a signal-circuit, and these fingers, like the fingers d^2, engage said switch-arm frictionally and hold it in such a manner that a little pull is required to disengage it. Thus the system includes two signal-circuits extending from the trolley-wire *a* at the ends of the block to the ground at the opposite ends thereof. The ground-wire *f*, to which the contact-fingers *e* are connected, includes in each box a visual signal *g*, which is herein shown as an incandescent lamp and is intended to serve as and constitute the safety-signal. Whenever the switch-arm *d* is moved from right to left, the signal-wire *b* will be opened at d^2 and the ground-wire *f* will be connected to one of the disconnected ends of the signal-wire at *e* through arm *d*, and consequently the safety-signal *g* will be included in the signal-circuit thus established at the box wherein said switch-arm is located and is thereby set or caused to glow, and the signal-circuit, including the signal-wire *b*, being thus established the danger-signal *c* at the opposite end of the block will be also set or caused to glow. In the diagram shown in Fig. 6 the signal-controlling switch in the left-hand box is thus moved and the safety-signal *g* in said box is set and the danger-signal *c* at the opposite end of the block is also set and the signal-circuit established which is represented by a wide line leading from the trolley-wire *a* at the leaving end of the block to the ground at the entering end of the block.

At each end of the block means are provided for operating the signal-controlling switch thereat to set the signals at both ends of the block, and said means are adapted to be operated by the trolley-wheel as the car enters the block. The means herein shown for accomplishing this result consist of a circuit-closing device adapted to be operated by the trolley-wheel as the car enters the block, a lighting-circuit operated by said circuit-closing device, and a lighting-magnet contained in and operated by said lighting-circuit. *h* represents the movable member of the circuit-closing device, and said member is arranged in such proximity to the trolley-wire as to be operated by a passing trolley-wheel, and said member is connected by a wire 2 permanently with the trolley-wire, and the stationary member of said circuit-closing device is connected by wires 3 and 13 with the ground-wire *f*, and whenever the trolley-wheel passes beneath either circuit-closing device *h* the said device is operated by said wheel and the ground-wire *f* momentarily connected with the trolley-wire and the lighting-circuit established which includes the wire 2, circuit-closing device *h*, wires 3 and 13, and the ground-wire *f*.

The lighting or signal-setting magnet *i* is included in the ground-wire *f*, which, as herein shown, is made as a stopped coiled solenoid set vertically in the box, the projecting end of its armature *i'* being notched or recessed to receive the outer end of an arm d^5, which is rigidly connected to the arm *d* of the sig-

nal-controlling switch. It is obvious that the arm d^5 may be otherwise connected with said armature, so as to be operated positively by it.

Normally the lighting-circuit 2 *h* 3 13 *f* at each end of the block is open at the trolley-operated circuit-closing device, as indicated by the diagram at the right hand of Fig. 6, and consequently the solenoid *i* is normally deënergized and its armature retracted; but whenever the circuit-closing device *h* is closed by the trolley-wheel passing beneath it and the said lighting-cirruit 2 *h* 3 13 *f* thereby established the solenoid *i* will attract its armature and move the arm d^5 and correspondingly move the switch-arm *d* from the position shown at the right, Fig. 6, to the position shown at the left, which opens the signal-wire *b* at d^2 and closes the ground-wire *f* with the signal-wire *b* at *e* and establishes the aforesaid signal-circuit, as represented by the wide line. The lighting or signal-setting magnet *i* therefore serves as the means for positively moving the signal-controlling switch to set the signals and is operated by the lighting-circuit. The current which passes from the trolley-wire over the lighting-circuit 2 *h* 3 13 *f* is only momentary, but is sufficient to energize the lighting-magnet *i* in order that the latter may move the switch-arm *d* from right to left and set the signals. The switch *d* when in engagement with the contact-fingers *e* positively connects the ground-wire *f*, including the safety-signal *g*, with the signal-wire *b* in such manner as to receive the current from the opposite or leaving end of the block, and as the danger-signal *c* is included in said signal-wire *b* at said leaving end of the block and has not been cut out by the switch-arm *d* thereat it is set, whereas the danger-signal *c* at the entering end of the block is cut out by the movement of the switch-arm *d* from right to left, as above described.

The operation of the parts caused by a car entering the block from either end is the same and is as follows: The circuit-closing device *h* is operated by the trolley-wheel and the lighting-circuit 2 *h* 3 13 *f* momentarily operated and the lighting-magnet *i* therein energized. The signal-controlling switch *d* is moved out of engagement with the contact-fingers d^2 and into engagement with the contact-fingers *e*, thereby opening the signal-wire *b* at d^2, cutting out the danger-signal *c* at the entering end of the block, and closing the ground-wire *f* at *e*, which includes the safety-signal *g*, with the signal-wire *b* at said entering end of the block, thereby establishing the signal-circuit *b f*, the current being taken from the current-carrying wire *a* at the leaving end of the block. The safety-signal *g* is thus set at the entering end of the block, and the danger-signal *c* is set at the leaving end of the block, and the lighting-magnet *i* is included in said signal-circuit, so as to remain energized while the signal-circuit remains closed. While the signals are thus set, if a loss of current occurs, the signal-lamps will cease to glow, but the armature *i'* of the lighting-magnet will remain in its attracted position by gravity and the switch-arm *d* will remain in engagement with the spring contact-fingers *e* by friction, so that when the current returns the parts will occupy the same position as when the current ceased and the signal-lamps will glow again.

At each end of the block a locking-magnet d^{10} is provided for the adjacent signal-controlling switch, which is adapted to positively hold said switch in its normal position, and thereby prevent it from being operated by the lighting-magnet *i* in case the lighting-circuit should be operated while the signals are set—as, for instance, by a car entering the block against a set danger-signal. The locking-magnet is herein represented as a solenoid, to the armature of which a rod d^{12} is attached, which when the solenoid is deënergized rests by gravity upon the armature *m'* of the put-out magnet *m*, or it may rest directly upon the arm d^6 of the signal-controlling switch and while thus supported is free to be moved upward by the signal-controlling switch, as it will be when said switch is moved from right to left to set the signals. The locking-magnets d^{10} are included in the signal-wire *b*, but adapted to be controlled by the signal-controlling switches—that is to say, each locking-magnet d^{10} is adapted to be cut out or disconnected by its adjacent signal-controlling switch when the latter is operated to establish the signal-circuit and set the signals. By referring to Fig. 6 it will be seen that the signal-controlling switch at the entering end of the block is always operated to establish the signal-circuit and set the signals, and consequently the locking-magnet at the entering end of the block is cut out or disconnected from the signal-circuit whenever the signals are set. The locking-magnet d^{10} at the opposite or leaving end of the block always remains included in the signal-circuit whenever the signals are set and is therefore energized and positively holds its armature in its attracted position with the rod d^{12} resting upon the armature *m'*, and as a result the signal-controlling switch at the leaving end of the block is positively held from being operated. While the signals are set, as represented by the diagram Fig. 6, if the lighting-circuit 2 *h* 3 13 *f* at the leaving end of the block should be closed and the lighting-magnet *i* energized the signal-controlling switch will not be operated, because it is positively held by said locking-magnet d^{10}. It will be seen that the armature of the locking-magnet d^{10} at each end of the block normally occupies its attracted position, it being supported by the armature *m'*, and when said magnet d^{10} is energized the arma-

ture is not moved, but is held positively against movement. Thus if a car should enter the block at the leaving end while the signals are set the signal-controlling switch thereat could not be operated.

To put out the signals when a car leaves the block, means are also provided adapted to be operated at either end of the block for returning the signal-controlling switch-arm *d* at the entering end of the block to its normal position. *k* represents the put-out wire, which extends from end to end of the block, and in each box an electromagnet is included in said wire *k*, herein shown as a solenoid *m*, having a tubular core and containing two armatures m' m^2, disposed in alinement and movable into and out of the tubular core in opposite ways. The armature m' is herein referred to as the "main" armature and the armature m^2 as the "secondary" armature. Each put-out magnet or solenoid *m* is set in an upright position, so that both main and secondary armatures are influenced by gravity when the magnets are deënergized. Each main armature m' has a notch which receives the outer end of an arm d^6, which is rigidly connected with the adjacent pivoted switch-arm *d*, so as to positively move said switch-arm when attracted and also be moved by said switch-arm into its retracted position when the magnet is deënergized and the lighting-magnet *i* is energized. Whenever the switch-arm *d* is moved by the lighting-magnet out of engagement with the contact-fingers d^2 and into engagement with the contact-fingers *e*, the armature m', connected therewith, will be moved into its retracted position, and whenever the armature m' is attracted the switch-arm *d*, connected therewith, will be disengaged from the contact-fingers *e* and moved into engagement with the contact-fingers d^2, and at the same time the armature i' of the adjacent lighting-magnet *i* will be moved into its retracted position. A wire k' leads from each put-out magnet *m* to the ground-terminal *f* of the signal-circuit, and each wire k' contains a normally open switch k^2, the movable member of which is attached to a vertical rod or bar k^3, which rests upon, but is not connected with, the armature i' of the lighting-magnet *i*, so that the switch k^2 at each end of the block will be operated by the lighting-magnet thereat. As the armature i' of each lighting-magnet *i* is normally in its retracted position, as represented at the right of Fig. 6, each switch k^2 will be normally held open, but will be closed whenever said armatures are attracted, as represented at the left, Fig. 6, and when closed the adjacent ground-terminal *f* of the signal-circuit will be connected with the put-out wire *k* through k'. Thus provision is made for connecting a ground-terminal to either end of the put-out wire *k* to assist in establishing two put-out circuits. To establish the put-out circuits and energize the put-out magnets or solenoids *m*, current is taken from the trolley-wire *a*, and to accomplish this result at each end of the block a circuit-closing device *n* is employed, which is represented as a pivoted arm located in such proximity to the trolley-wire as to be engaged by a passing trolley-wheel—as, for instance, by a car leaving the block—and whenever said circuit-closing device *n* is operated the current passes from the trolley-wire *a* at the leaving end of the block, over wire 4, arm *n*, wires 5, k', and *k*, to the opposite end of the block, including both put-out magnets *m*, then over wire k' at the opposite or entering end of the block, switch k^2, and ground-terminal *f* to ground. Thus the two put-out circuits will be separately established, according to which circuit-closing device *n* is operated. The operation of the circuit-closing device *n* is only momentary, yet is sufficient to cause both put-out magnets or solenoids *m* to become energized, and the armature m' of the put-out magnet at the entering end of the block will be attracted, and the signal-controlling switch-arm *d* will be restored to its normal position, thereby putting out the signals by opening the signal-circuit, and the armature i' of the lighting-magnet *i* at the entering end of the block will be also returned to its attracted position, and the switch k^2 will be opened; but the armature m' of the put-out magnet or solenoid at the leaving end of the block, being already in its attracted position, will not be moved, although said put-out magnet will be energized. Thus it will be seen that the two put-out magnets are arranged in series in either put-out circuit, and that the put-out circuits each have a normally open ground-terminal, and that the switch for closing the ground-terminal connection is operated by the adjacent lighting-magnet, and all the current will pass from the trolley-wire *a* through both put-out magnets to one of the ground terminals from the leaving end of the block to the entering end thereof whenever either put-out circuit is operated by the trolley-operated circuit-closing device *n*.

By resting the rod k^3, bearing the movable member of the switch k^2, on the armature i' instead of attaching it to said armature said rod will have a movement, due to momentum, which is independent of and in addition to the movement of said armature. In practice the armature i' is moved into its attracted position suddenly; but the distance which it travels is short, and the movable member of the switch k^2 will be likewise moved suddenly, and the sudden movement thus given to the movable member of the switch k^2 is so great as to cause said member to move independently a short distance beyond the armature by the momentum imparted to it, and such

further movement of said member positively insures the breaking of any arc that may be produced by the opening of said switch.

A switch is included in each lighting-circuit 2 *h* 3 13 *f*, which is normally closed, but which is adapted to be opened by the adjacent signal-controlling switch when said switch has been operated to set the signals, thereby opening the lighting-circuit as soon as it has performed its required functions. This prevents the momentary glowing of the safety-signals at both ends of the block in case the danger-signal lamp burns out while the signals are set and a car should enter the block at the leaving or danger end while the signals are set but after the danger-signal has burned out. The switch thus provided in the lighting-circuit at each end of the block may be of any suitable construction, but is herein represented as comprising a movable member *w*, (see Fig. 4,) attached to a stem *w'*, which latter rests upon the top of the armature of the locking-magnet d^{10}, but is not connected therewith, and the stationary members w^2 w^3, one of which is connected to the wire 3 and the other to the wire 13. As the armature of the locking-magnet d^{10}, upon which the stem *w'* rests, is connected to a stem d^{12}, which rests upon the top of the armature *m'* of the put-out or extinguishing magnet, and as said armature *m'* is connected with the arm d^6 of the signal-controlling switch, it will be seen that whenever said signal-controlling switch is moved from right to left to set the signals the armature *m'*, stem d^{12}, armature of the locking-magnet d^{10}, stem *w'*, and movable member *w* of the switch will be lifted positively and the switch *w* w^2 w^3 thereby opened, thus opening the lighting-circuit. The switch *w* w^2 w^3 is thus operated by the signal-controlling switch; but we do not limit our invention to the particular construction of means herein shown for operating said switch *w* w^2 w^3 by the signal-controlling switch, as it is obvious that other means may be employed. Whenever the signals are set, the switch *w* w^2 w^3 at the entering end of the block will be opened, and in case the danger-signal lamp *c* at the leaving end of the block should be burned out while the signals are thus set the signal-circuit will be opened; but the signal-controlling switch at the entering end of the block will still remain set, so that if a car should enter the block at the leaving end while the signals are set and the danger-signal burned out the lighting-circuit 2, *h*, 3, w^2, *w*, w^3, 13, and *f* at the leaving end of the block will be closed and the lighting-magnet *i* energized and the signal-controlling switch operated and the switch *w* w^2 w^3 opened at said leaving end of the block, thereby preventing the safety-signal *g* from glowing momentarily while the lighting-circuit is thus established. If said switch *w* w^2 w^3 were not provided, the current would momentarily pass over 2 *h* 3 13 *g f e d b* to entering end of the block and over *d e f g*, including the lighting-magnet *i* at said entering end of the block, and thereby cause both safety-signal lamps *g* to glow, while the circuit-closing device *h* acted to hold the lighting-circuit closed at the leaving end of the block. Thus the importance of said switch *w* w^2 w^3 will be seen. The switches *w* w^2 w^3 at each end of the block will be closed by the adjacent put-out magnet when the latter operates to restore the signal-controlling switch, or it may be otherwise closed by the returning signal-controlling switch.

Around each safety-signal lamp *g* a shunt-circuit is provided, which, as herein shown, consists of the wires 30 and 31, and a high-resistance circuit-closer is included in said shunt-circuit, which consists of a spring-acting arm 32, bearing upon a small piece of paper 33, which is laid on an arm 34, and said arm 32 is connected with the wire 30, and the arm 34 is connected with the wire 31. By means of said high-resistance circuit-closer the shunt-circuit is normally held open; but in case the safety-signal lamp *g* burns out the current will puncture the paper 33 and permit the spring-acting arm 32 to close on the arm 34, and thereby close the signal-circuit at this point. Otherwise the signal-circuit would be opened and the danger-signal extinguished.

Around each danger-signal lamp *c* a shunt-circuit is provided, which, as herein shown, consists of the wires 35 and 36, and a high-resistance circuit-closer is included in said shunt-circuit, which consists of a spring-acting arm 37, bearing upon a small piece of paper 38, which is laid on an arm 39, and said arm 37 is connected with the wire 35, and the arm 39 is connected with the wire 36. By means of said high-resistance circuit-closer the shunt-circuit is normally held open; but in case the danger-signal lamp *c* burns out the current will puncture the paper 38 and permit the spring-acting arm 37 to close on the arm 39, and thereby close the signal-circuit at this point. Otherwise the signal-circuit would be opened and the safety-signal extinguished.

Either signal-circuit when established includes a permanent connection with the trolley-wire at the leaving end of the block and a ground connection *f* at the opposite or entering end of the block, and in addition to the signal-lamps *c* and *g* glowing the lighting-magnet *i* at the entering end of the block remains energized, and therefore continues to positively hold the signal-controlling switch *d* in the position shown at the left of Fig. 6, as it is designed and intended that the pull of the put-out magnet *m* at such time shall not be sufficient to overcome the pull of the lighting-magnet *i*. In accomplishing this result

the attractive force of the put-out magnet *m* for its armature is reduced when the lighting-magnet is operated, as will be described.

A second switch or circuit-closer is provided at each end of the block, which is included in the signal-wire *b* and which is herein shown as a plate *o*, normally engaging a pair of contact-pieces *o'*, which are connected with the signal-wire, and said switch normally maintains said signal-wire closed; but when the plate *o* is moved out of engagement with said pieces *o'* the signal-wire at this point will be opened. For simplicity of construction the plate *o* is connected with the secondary armature m^2 of the put-out magnet *m*, so as to be operated by it whenever said magnet is energized. Therefore whenever one of the circuit-closing devices *n* is operated to connect the put-out wire with the trolley-wire and both solenoids *m m* are energized both switches *o o'* and *o o' x* will be operated, and the operation of the one that is located at the leaving end of the block will open the signal-circuit, causing the lighting-magnet *i* at the opposite or entering end of the block to deënergize, and thereby permit the put-out magnet *m* at said entering end of the block to attract its armature *m'* and restore the switch-arm *d*. The operation of the switch *o o'* at the entering end of the block will produce no result. Thus to restore the switch-arm *d* both put-out magnets are required to operate, one to lift, and thereby open the second switch *o o'*, which controls the signal-circuit, and the other to attract its main armature, and thereby positively return the switch-arm *d* when permitted so to act by the lighting-magnet *i* becoming deënergized. In case the wires are crossed the current will pass over the put-out wire and through the put-out magnet *m* at the entering end of the block, and it is of the utmost importance that the put-out magnet *m* thereat shall not be energized sufficiently to attract its armature *m'*, because in such case the signal-controlling switch-arm *d* will be restored and the safety-signal *g* restored to normal or extinguished. Each put-out magnet *m* is therefore constructed to exert a variable attractive force on its armatures, so that the put-out magnet *m* at the entering end of the block may be adjusted in such manner that its attractive force is materially reduced when the signals are set, and as a result it will not overcome the pull of the lighting-magnet *i* and also will not attract its armatures as quickly as the put-out magnet *m* at the opposite or leaving end of the block. This variation in the attractive force exerted is obtained by providing an air-gap in the core of the put-out magnet *m* of varying dimensions, as when the air-gap is large the attractive force of the magnet is correspondingly less than when said air-gap is small. This air-gap is represented at *q*, Fig. 4, and in said figure is reduced to its minimum size, as it will be in the put-out magnet at the leaving end of the block when the signals are set; but in the put-out magnet at the entering end of the block when the signals are set the armature *m'* is witndrawn from the core mechanically by the lighting-magnet into its retracted position and the air-gap is increased to such an extent that the attractive force of the put-out magnet is materially diminished, and as a result the put-out magnet becomes sluggish or slower to act. It will be seen that in case the put-out wire receives current from the signal-wire or the trolley-wire or other current-carrying wire the armature *m'* of the put-out magnet at the entering end of the block will not be attracted, and hence will not operate the signal-controlling switch and restore the signals unless the lighting-magnet *i* is first deënergized.

The lighting-magnets *i* are made weaker than the put-out magnets even when the armatures *m'* of said put-out magnets are in their retracted positions, as they will be whenever the signal-controlling switches are operated, so that in case two cars should enter the block at the same time and operate both signal-controlling switches the first car which backs off the block will operate the put-out or extinguishing circuit and restore both signal-controlling switches.

By referring to Fig. 6 it will be seen that if two cars should enter the block at the same time and operate both signal-controlling switches no signal-lamps will glow, yet said switches will be set and the block will be tied up, and the car which first backs off of the block closes the circuit-closing device *n* and operates the extinguishing-circuit and energizes both put-out magnets *m*, yet at the same time the current would pass over the signal-circuit and operate to energize both lighting-magnets, and if the put-out magnets were not made stronger than the lighting-magnets said lighting-magnets would so hold the signal-controlling switches that they would not be restored. The abnormal path for the current in such case over the signal-circuit may be traced as follows, assuming that the car backs off of the block at the right-hand end: *k' k² f*, lighting-magnet *i f*, signal-lamp *g e d b* to the opposite end of the block, then *d e f*, signal-lamp *g f*, lighting-magnet *i f* to ground. Thus the importance of making the put-out magnets *m* stronger than the lighting-magnets *i* will be understood.

Referring to Fig. 2, A represents the box or housing which contains the signal-lamp *g* and *c* and the switches and other operating mechanism, and in one wall of said box in front of the danger-signal lamp *c* a lens or disk c^{20} of red glass is provided, and in back of the safety-signal lamp *g* a lens or disk g^{20} of uncolored glass is provided, and in the opposite wall of the box in front of the safety-signal lamp *g* a lens or disk g^{21} of green glass

is provided, and said lenses or disks g^{20} and g^{21} are located opposite each other, the safety-signal lamp being located between them.

Many of the features herein described are described and claimed in the application above referred to, and hence are not herein claimed.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a block-signal having a danger-signal and a safety-signal at each end of the block and signal-circuits therefor, a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block for operating the signal-controlling switch thereat, and circuits therefor, a locking-magnet at each end of the block, operated by one of the signal-circuits, for holding the adjacent signal-controlling switch in its normal position, substantially as described.

2. In a block-signal having a danger-signal and a safety-signal at each end of the block and signal-circuits therefor, a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block for operating the signal-controlling switch thereat, and circuits therefor, a locking-magnet at each end of the block, operated by one of the signal-circuits, the armatures of which are mechanically connected with the adjacent signal-controlling switches, substantially as described.

3. In a block-signal having a danger-signal and a safety-signal at each end of the block and signal-circuits therefor, a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block for operating the signal-controlling switch thereat, and circuits therefor, a locking-magnet at each end of the block, operated by one of the signal-circuits and controlled by the adjacent signal-controlling switch for holding said signal-controlling switch in its normal position, substantially as described.

4. In a block-signal having a danger-signal and a safety-signal at each end of the block, and circuits therefor, a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block for operating the signal-controlling switch thereat, circuits for the put-out magnets having normally open ground-terminals, means for operating said circuits, and a switch at each end of the block, operated by the adjacent lighting-magnet, for closing the adjacent ground-terminal of the put-out circuit, substantially as described.

5. In a block-signal having a danger-signal and a safety-signal at each end of the block, and circuits therefor, a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block for operating the signal-controlling switch thereat, circuits for the put-out magnets having normally open ground-terminals, means for operating said circuits, and a switch at each end of the block, operated by the adjacent lighting-magnet, for closing the adjacent ground-terminal of the put-out circuit, and operated by the adjacent put-out magnet for opening said ground-terminal, substantially as described.

6. In a signaling apparatus, a vertically-disposed solenoid, a switch, a vertical rod to which the movable member of said switch is attached, said rod resting upon the armature of said solenoid whereby it is free to move independently of said armature by the momentum imparted to it by the sudden retractive movement of said armature, substantially as described.

7. In a block-signal having a danger-signal and a safety-signal at each end of the block and signal-circuits therefor, a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block, for operating the signal-controlling switch thereat, circuits for the lighting-magnets and circuits for the put-out magnets, and a normally open switch in each lighting-circuit adapted to be operated by the adjacent signal-controlling switch, substantially as described.

8. In a block-signal having a danger-signal and a safety-signal at each end of the block, and circuits therefor, a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block for operating the switch thereat, circuits for the lighting-magnets and circuits for the put-out magnets, a normally closed switch in each lighting-circuit and means operated by each lighting-circuit for operating the switch included therein, and means operated by the put-out circuits for operating said switches to close the lighting-circuits, substantially as described.

9. In a block-signal having a danger-signal lamp and a safety-signal lamp at each end of the block, and circuits therefor, a lighting-magnet at each end of the block, and means operated by it for setting said signal-lamps, circuits for said lighting-magnets, and a normally open shunt-circuit around each safety-signal lamp including a high-resistance circuit-closer adapted to be operated by the inductive action of the adjacent lighting-magnet in case the safety-signal lamp burns out while the signals are set, substantially as described.

10. In a block-signal having a danger-signal and a safety-signal at each end of the block, circuits therefor, and a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block, said lighting-magnets being made weaker than the put-out magnets, circuits for the lighting-magnets, and circuits for the put-out magnets, substantially as described.

11. In a block-signal having a safety-signal

and a danger-signal at each end of the block, circuits therefor, and a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block and a housing for the same, said housing having lenses opposite the said safety and danger signal lamps, the lenses opposite the safety-signal lamp being two in number and on opposite sides thereof and of different color, substantially as described.

12. In a block-signal having a safety-signal and a danger-signal at each end of the block, circuits therefor, and a signal-controlling switch at each end of the block, a lighting-magnet and a put-out magnet at each end of the block and housing for the same, said housing having lenses opposite the said safety and danger signal lamps, the lenses opposite the safety-signal being two in number and giving different geometrical dispersion to the rays of said lamp, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

CHARLES H. MORSE.
CHARLES F. HOPEWELL.

Witnesses:
B. J. NOYES,
H. B. DAVIS.