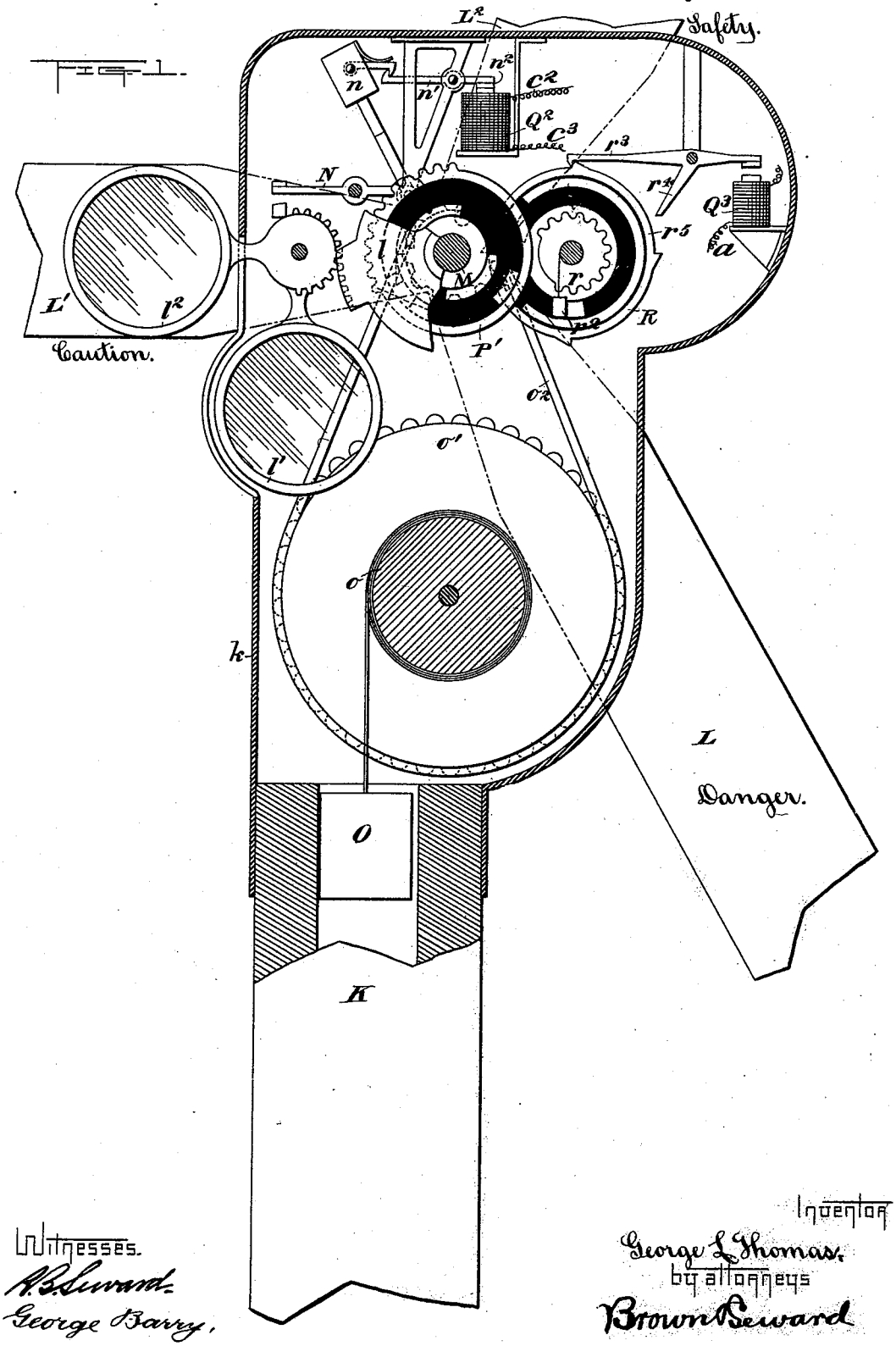
(No Model.) 8 Sheets—Sheet 1.

G. L. THOMAS.

BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.

Fig. 1.



Witnesses.
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(No Model.) 8 Sheets—Sheet 2.

G. L. THOMAS.

BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.

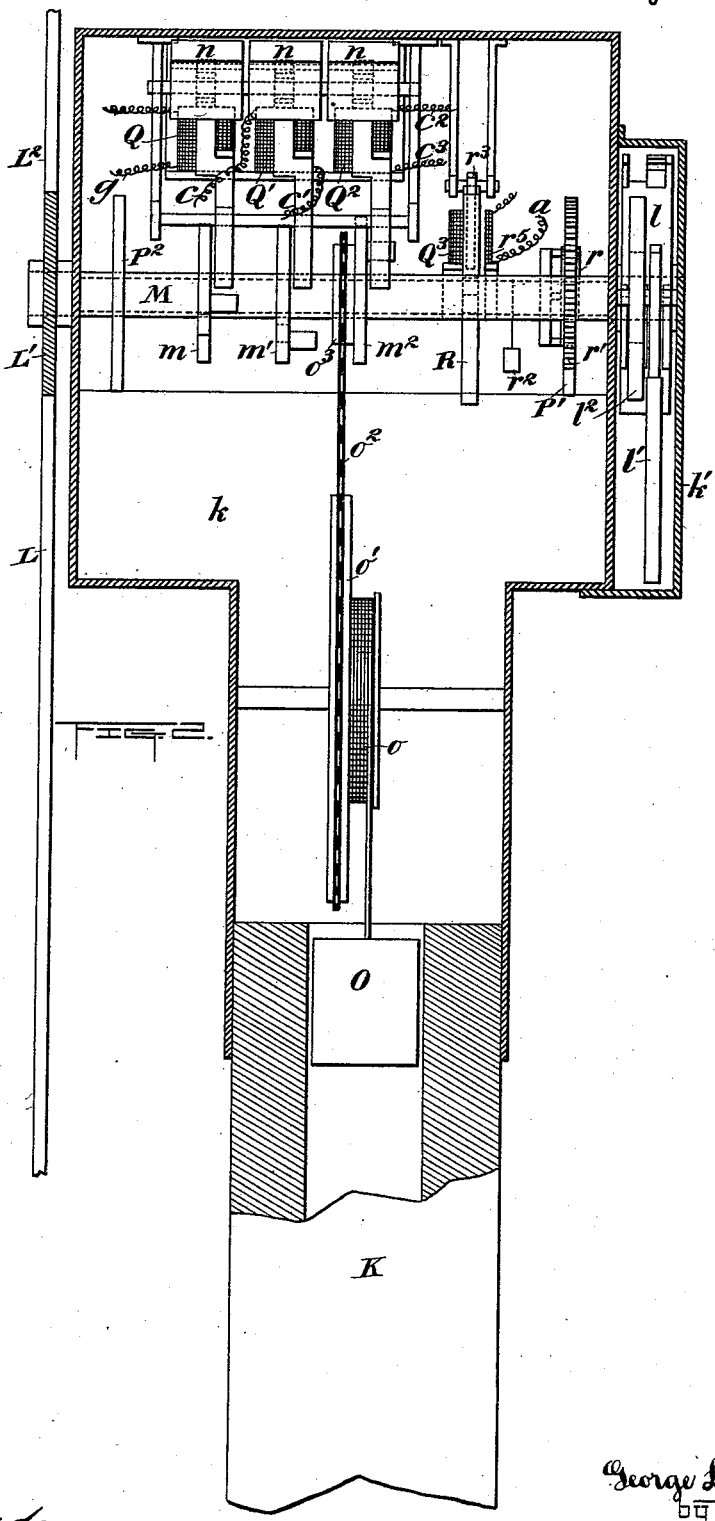

FIG. 2.

Witnesses.
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(No Model.) 8 Sheets—Sheet 3.

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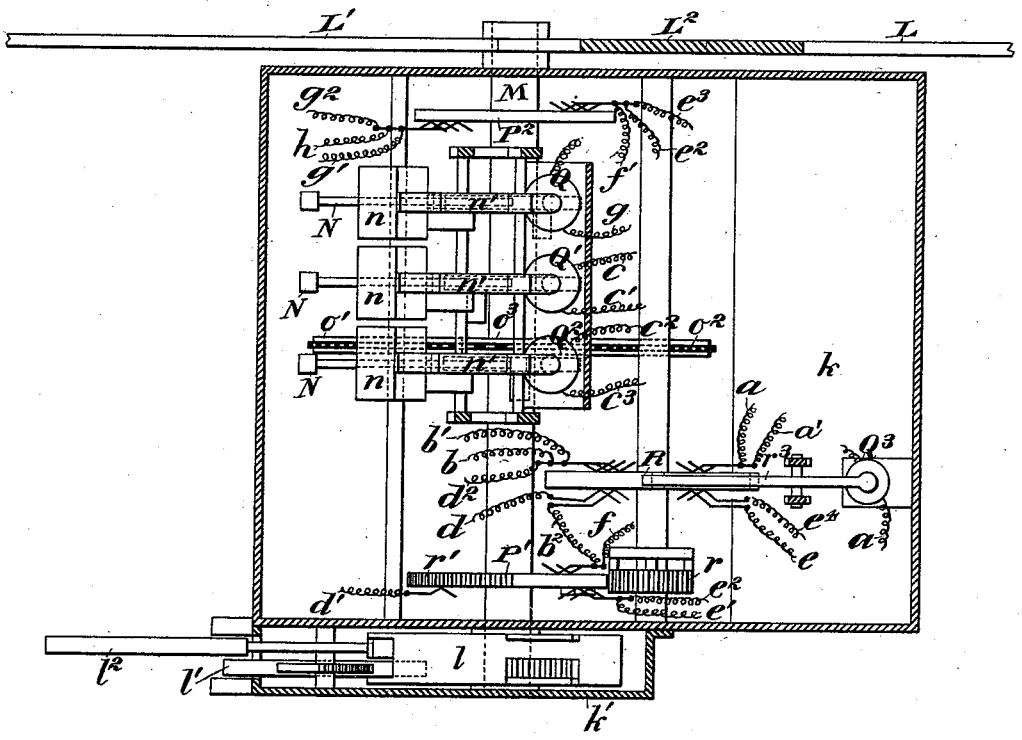
BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.

FIG. 3.



Witnesses.
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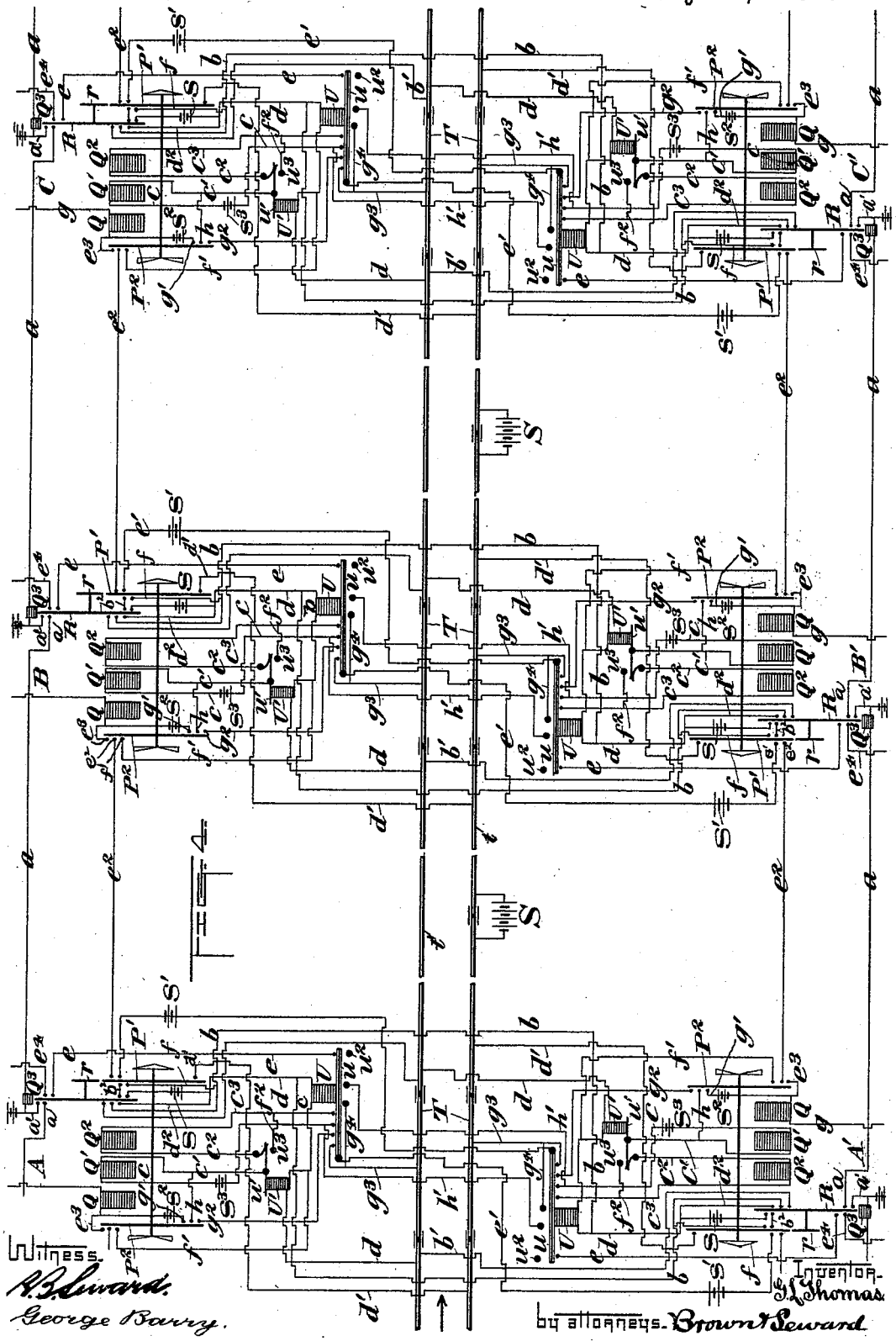
(No Model.) 8 Sheets—Sheet 4.

G. L. THOMAS.

BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.



Witness.
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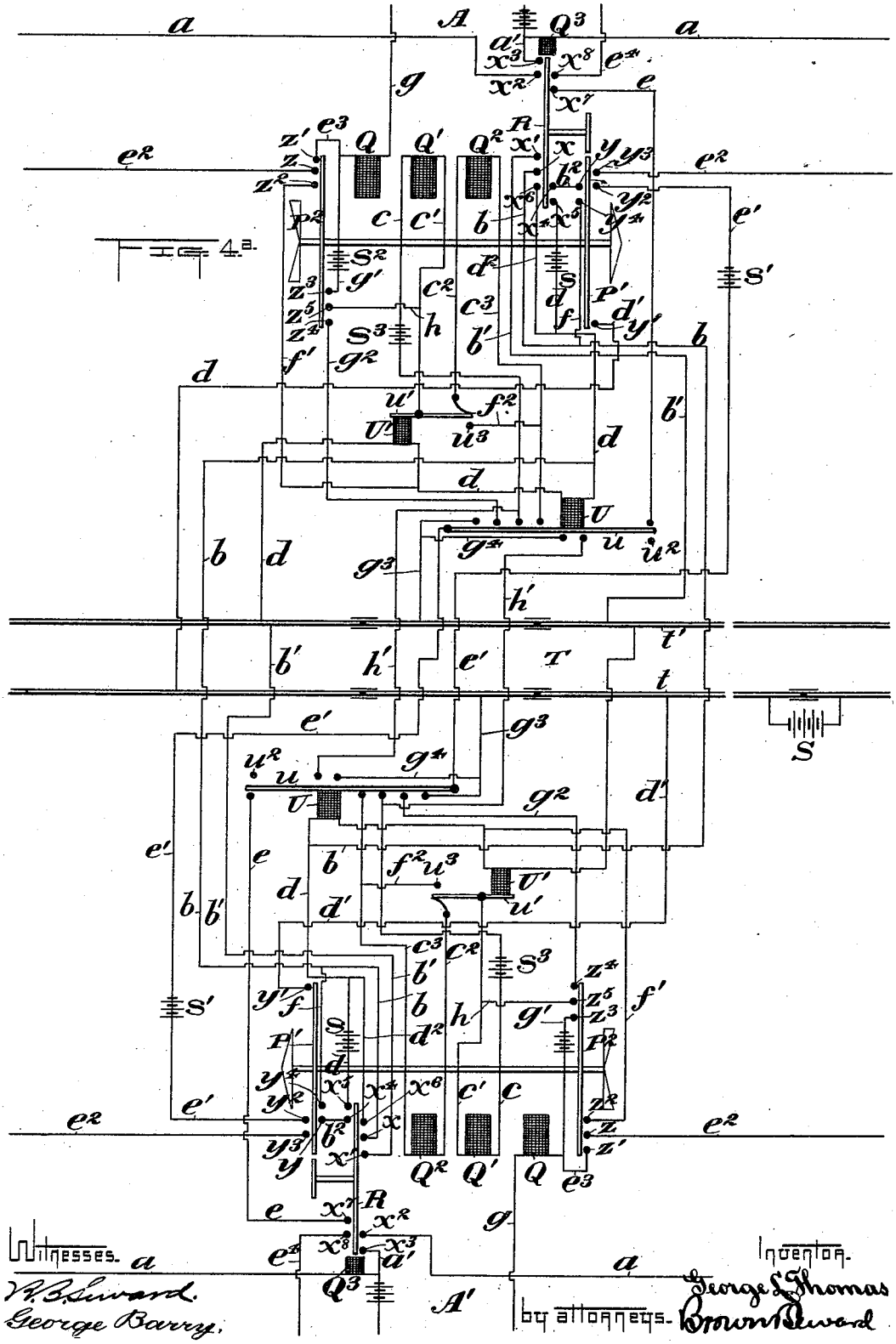
(No Model.) 8 Sheets—Sheet 5.

G. L. THOMAS.

BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.



Witnesses.
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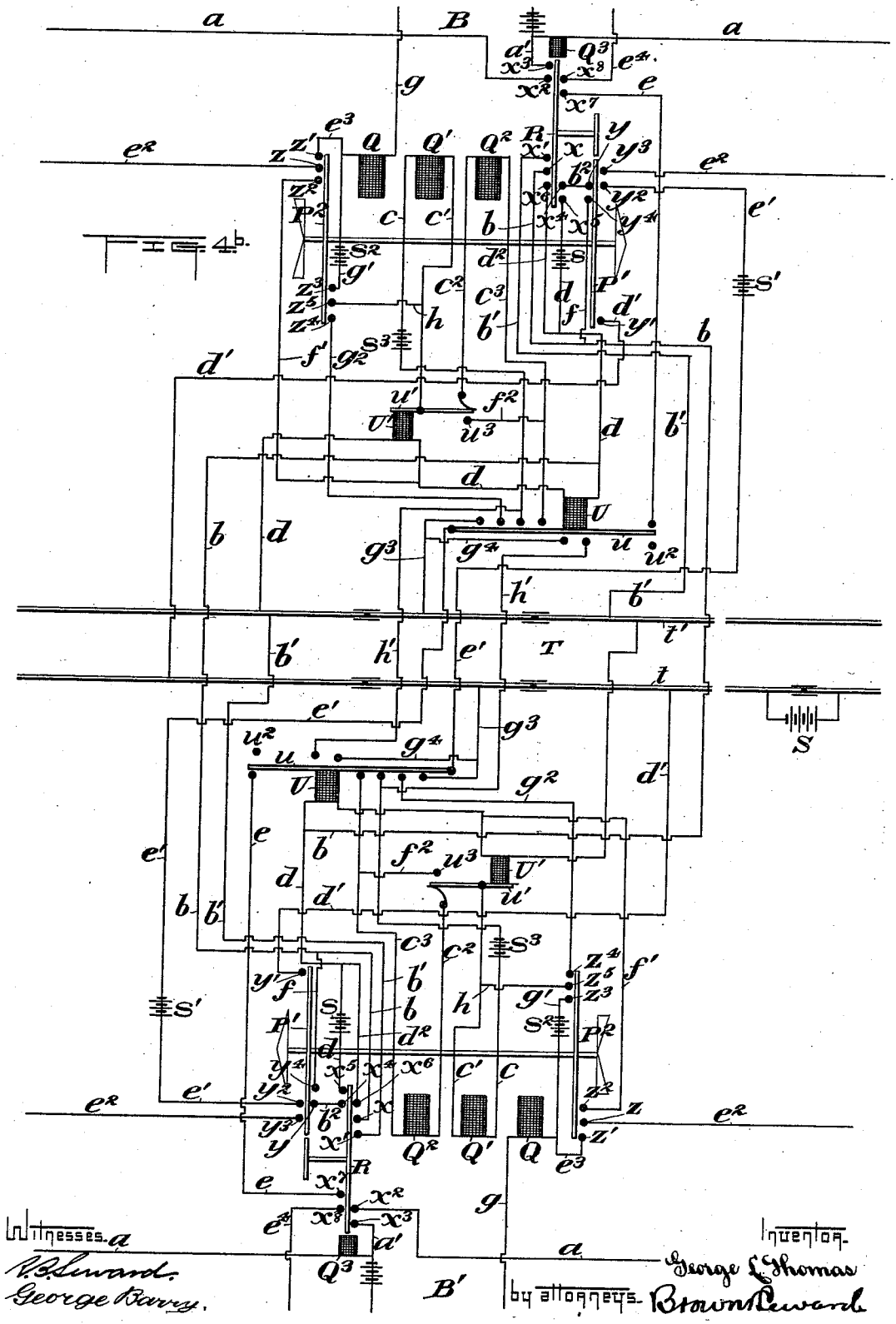
(No Model.) 8 Sheets—Sheet 6.

G. L. THOMAS.

BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.



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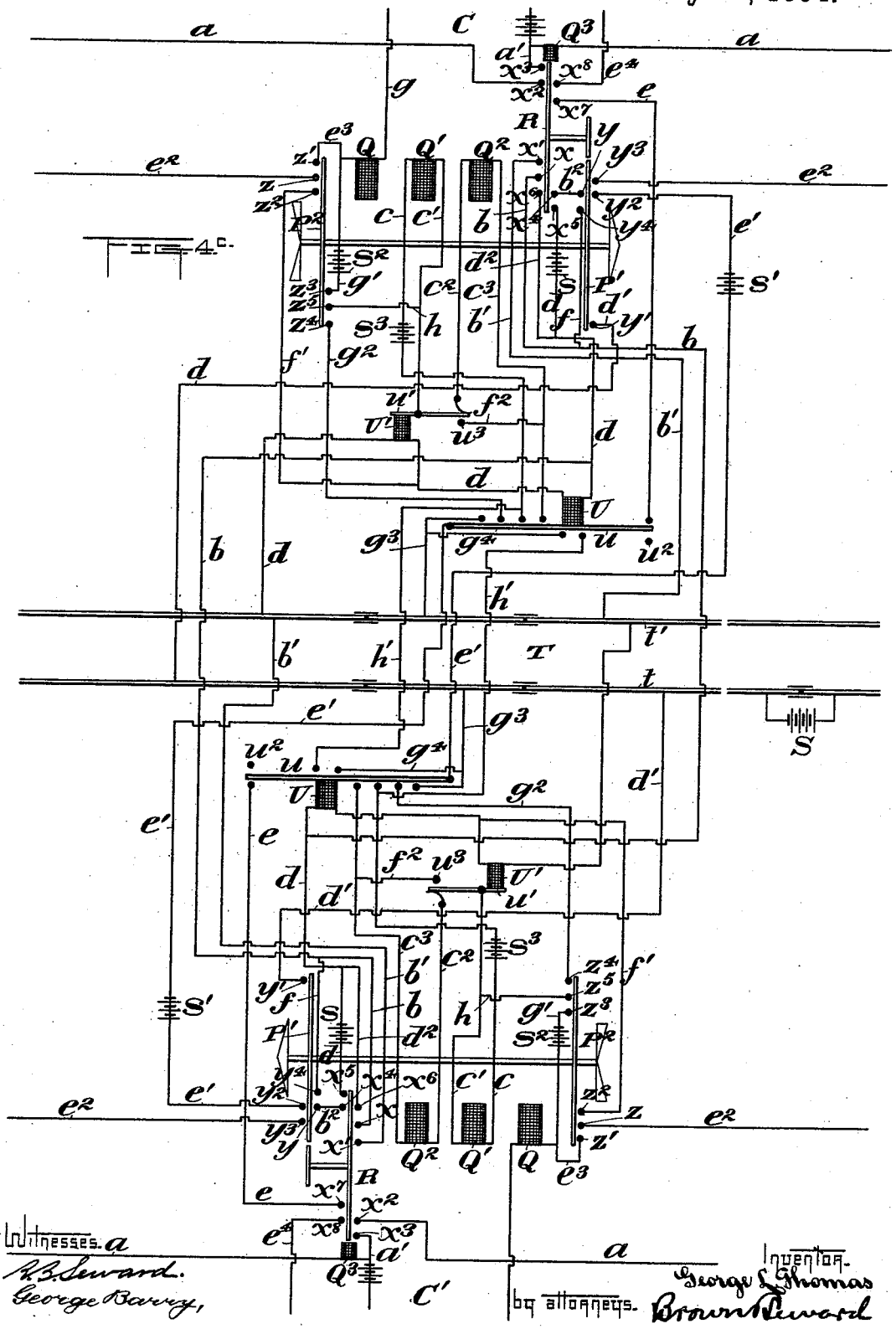
(No Model.) 8 Sheets—Sheet 7.

G. L. THOMAS.

BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.



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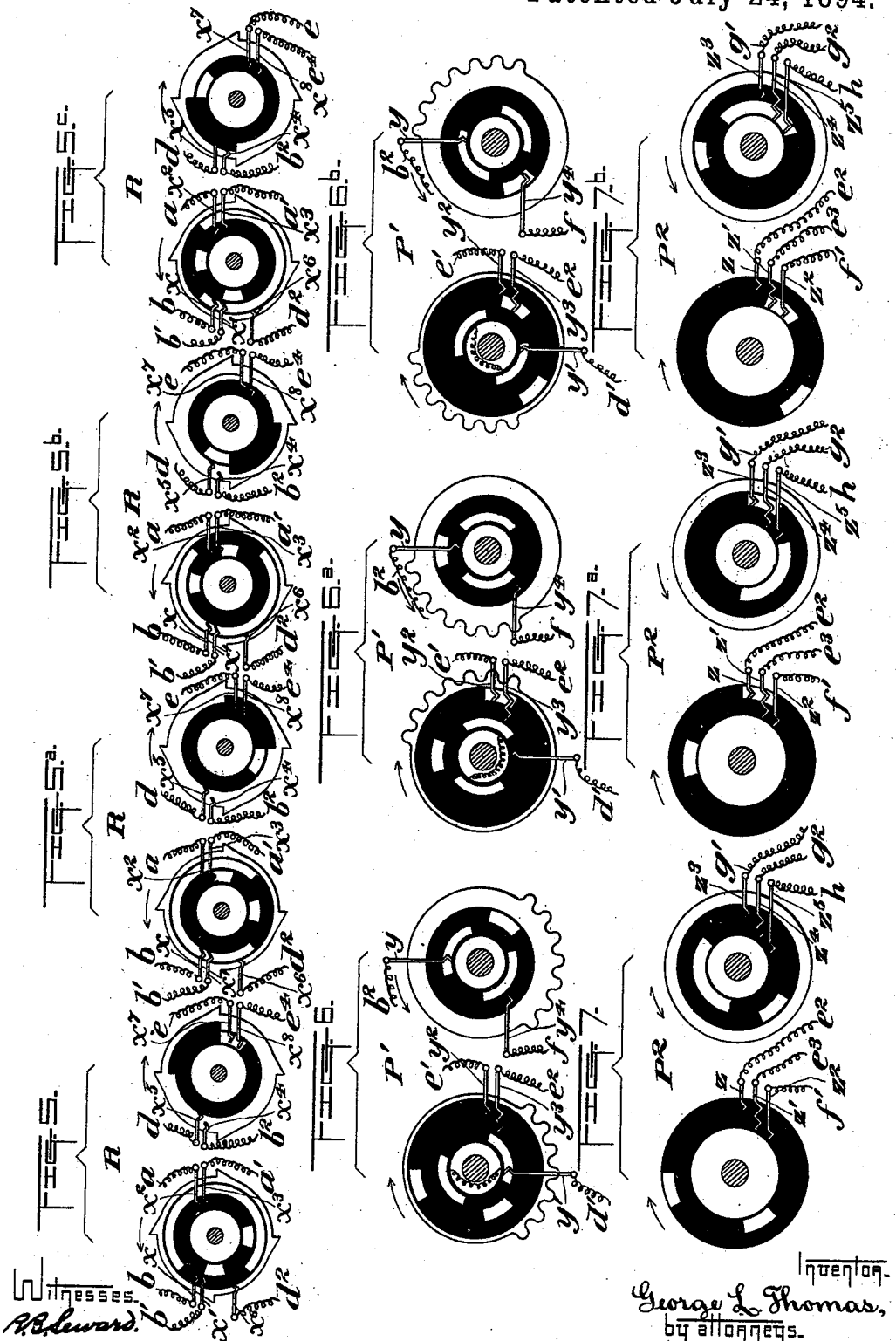
(No Model.) 8 Sheets—Sheet 8.

G. L. THOMAS.

BLOCK SIGNAL SYSTEM.

No. 523,491. Patented July 24, 1894.



Witnesses.
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Inventor.
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by attorneys.
Brown & Seward

UNITED STATES PATENT OFFICE.

GEORGE L. THOMAS, OF BROOKLYN, ASSIGNOR TO THE HASELL PERFECTED RAILWAY SIGNAL COMPANY, OF NEW YORK, N. Y.

BLOCK-SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 523,491, dated July 24, 1894.

Application filed March 26, 1894. Serial No. 505,057. (No model.)

To all whom it may concern:

Be it known that I, GEORGE L. THOMAS, of Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement in Block-Signal Systems, of which the following is a specification.

My invention relates to an improvement in block signal systems in which series of signals arranged along the track and connected by electric circuits, in the present instance by track circuits, are under the control of a train moving in either direction, each series serving as rear signals and header signals according to the direction in which the train is moving, the one series serving as rear signals when the other is serving as header signals.

My invention further contemplates the placing of the signals normally in auxiliary circuit independently of the main track circuit or the line circuit for preventing the disturbance of the signals, either by accidentally or mischievously forming an electrical connection between the rails or by the running of a workman's hand car along the block, until the approaching train has reached a point within such distance of the signal as to take control of the signal itself and thereby render the further guarding of the signal by the auxiliary circuit unnecessary.

My invention further contemplates provision for dropping the semaphore arms into an abnormal position in case of breakage of the cord or chain which sustains the signal actuating weight.

In the accompanying drawings:—Figure 1 is a view of one of the towers in side elevation, partly in section, showing the signal operating mechanism therein. Fig. 2 is a vertical section through the tower in a plane parallel with the track, showing the operative parts in the tower in face elevation, looking from the track toward the tower. Fig. 3 is a horizontal section through the tower, showing the operating parts in top plan and the positions of the contact pieces for making and breaking the several electric circuits. Fig. 4 is a diagrammatical view, representing three successive sets of towers, together with the electric circuits which inter-connect the members of each set and which connect the several successive sets, the towers and the signals and their actuating mechanism being represented in this view conventionally, it being understood that each member of the several sets is quite similar to the tower and its signals and signal actuating mechanism shown in detail in Figs. 1, 2 and 3. Figs. 4^a, 4^b and 4^c represent, respectively, upon an enlarged scale, the sets of towers A, A′, B, B′ and C, C′, shown diagrammatically. Figs. 5, 5^a, 5^b and 5^c represent the opposite sides of the disk R, in the positions of normal, advanced one step, advanced two steps and advanced three steps, respectively. Figs. 6, 6^a and 6^b represent the opposite sides of the disk P′ in the position of normal or with the signal at safety, advanced one step, or with the signal at danger, and advanced two steps, or with the signal at caution, respectively, and Figs. 7, 7^a and 7^b represent the opposite sides of the disk P^2 in the position of normal or with the signal at safety, advanced one step or with the signal at danger, and advanced two steps, or with the signal at caution, respectively.

The body or trunk of the tower is denoted by K. It is made hollow for the reception of the weight which is employed to actuate the signals when released and is surmounted by a hollow casing *k* for the reception of the operating parts. The particular shape of the casing *k* is a matter of choice and will be determined by the demands of expediency and arrangement of the various operative parts.

The signal arms; three in number, representing respectively danger, caution and safety; are denoted respectively by L, L′, L^2 and are fixed to rotate with a spindle M mounted in suitable bearings in the casing *k* and, extending through to the outside of the casing upon opposite sides thereof, the signal arms being secured to one end of the shaft exterior to the casing and the spectacle operating disk *l* being secured to the opposite end of the shaft exterior to the main casing *k* but housed within the supplemental casing *k′* which is provided for the purpose of receiving the spectacles *l′* and l^2 within it when they are dropped from their raised or signaling positions.

The spindle M is provided with three disks *m*, *m′* and m^2, each provided with a tooth or abutment on its face for the purpose of en-

gaging vibrating dogs M to arrest the rotary movement of the spindle N in the proper position to bring the signal arms to indicate danger, caution and safety. The spindle M is normally under tension tending to rotate it toward the holding ends of the dogs N, such tension being in the present instance mechanically applied by means of a weight O suspended from a drum *o*, connected with a sprocket wheel *o'*, the latter connected by a sprocket chain o^2 with a sprocket pinion o^3 fixed on the spindle M.

The dogs N are operated to release the disks *m*, *m'*, m^2 and hence the spindle M and the signal arms, by the dropping of the hammers *n* on their free ends. The hammers *n* are held suspended by means of hook levers *n'*, carrying on their arms armatures n^2 under the control of electromagnets Q, Q' and Q^2, there being one hook lever *n'* and armature n^2 corresponding to each hammer, electro magnet and dog N. In the present example of my invention, the hook levers *n'* of the magnets Q' and Q^2 are arranged to release their hammers by the de-energizing of the magnets Q' and Q^2, while the lever *n'* of the magnet Q is arranged to be released by the energizing of its magnet Q, a simple reversal of parts, and one which will be readily understood. The magnet Q holds the signal at danger, the magnet Q^2 holds it at caution and the magnet Q' holds it at safety.

The general arrangement and operation of the parts as thus far described, with the exception of the drop hammers for releasing the signal arm spindle, are similar to that shown, described and claimed in Patent No. 508,356, granted to Thomas and Seward on the 7th day of November, 1893.

The disk R is mounted to rotate independently of the spindle M when the signal is at safety and there is a mutilated toothed pinion *r* fixed to rotate with the disk R and in position to engage a mutilated gear *r'* on a disk fixed on the spindle M whenever the disk R is turned from its normal position. The disk R is actuated a predetermined distance by a weight r^2 which is permitted to drop a distance just sufficient to rotate the disk R a predetermined distance, in the present case a distance equal to about three-fourths of a complete revolution. When the said disk R has so rotated, while the signal is at safety, the rotary movement of the signal from safety to danger will, by the engagement of the mutilated gear *r'* with the gear on the pinion *r*, return the disk R to its normal position, no matter whether it has been rotated to the full extent of its rotary movement or only to a partial extent.

The disk R is retained in position to operate under the impulse of the weight r^2, when released, by a pawl r^3 under the control of an electro magnet Q^3. The pawl r^3 is provided with an arm r^4 which, after the pawl is released from the disk R will momentarily arrest the rotary movement of the disk until the magnet Q^3 is de-energized, thereby permitting the hooked end of the pawl r^3 to fall, under the influence of gravity, into position to catch the next succeeding tooth on the disk R.

The step by step rotary movement of the disk R under the impulse of the weight r^2 is utilized to make and break electric circuits for operating the header signal in a companion tower, as will be particularly described in connection with the explanation of the diagram Fig. 4. For this purpose, the disk is provided with insulating material r^5 and contact pieces on its face and so interrupted as to produce the necessary closure of the contact fingers in electrical circuit in any well known or approved manner for the purposes in hand.

As the particular arrangement which may be adopted for the purposes of making and breaking the circuits may be readily determined by a person skilled in the art to suit the particular purposes in hand, it is not thought necessary to go into details of the particular shapes of the surfaces which effect the closure of the contact fingers as the disk rotates. The disk P' carrying the mutilated gear *r'* is also provided on its opposite faces with contact pieces at suitable intervals to make the necessary electric connections during the rotary movement of the signal spindle and the said spindle is further provided with a disk P^2 for making additional contacts during the rotary movement of the signal spindle. The location of the several banks of contact fingers which I employ in connection with this particular arrangement of contact disks is represented in Fig. 3, conducting wires leading from the contact fingers being denoted by the letters which are employed in connection with the diagram Fig. 4 and Figs 4^a, 4^b and 4^c, to indicate the circuits under consideration.

Referring to the detail view of the disk R, Figs. 5, 5^a, 5^b and 5^c; the contact fingers *x* and *x'* at the terminals of the wires *b*, *b'* are electrically insulated when the disk is at normal, Fig. 5, but become electrically connected as soon as the disk makes the first part of its movement and remain connected until the said disk is returned again to its normal position.

The contact fingers x^2, x^3 at the terminals of the wires *a*, *a'* are electrically insulated when the disk is at normal and remain so during the movement of the disk its first step. During its second step they are first electrically connected and then insulated and during its third step they are again electrically connected and then insulated. During the return movement of the disk to its normal position, they are again twice electrically connected and insulated, but only one such make and break during the return affects the subsequent disks for the reasons fully given elsewhere.

The contact fingers x^4, x^5, x^6 at the termi-

nals of the wires b^2, d, d^2 are electrically connected and insulated as follows:—When the disk R is at normal and during its first and second steps, b^2 is electrically connected with both d and d^2. But, when the disk passes through its third or final step d is insulated and the electric connection is between b^2 and d^2 only.

The contact fingers x^7 and x^8, at the terminals of the wires e and e^4 are electrically connected when the disk R is at normal and electrically insulated at all other positions of the disk.

Referring to the detail views of the disk P′, Figs. 6, 6^a and 6^b, the contact fingers y, y', at the terminals of the wires b^2 and d' are electrically connected when the said disk is at normal or when the signal is at safety and also when the signal is at caution and the disk in the position shown in Fig. 6^b, and are insulated when the disk is in the position shown in Fig. 6^a or the signal at danger.

The contact fingers y^2, y^3, y^4 at the terminals of the wires e', e^3 and f at the disk P′ are electrically connected and insulated as follows:—When the said disk is in position with signal at "safety," Fig. 6, they are insulated; when in the position of "danger," Fig. 6^a, e' and e^2 are electrically connected and f cut out, and when in the position of "caution" Fig. 6^b, e^2 and f are electrically connected and e' cut out.

Referring to the detail views of the disk P^2, Figs. 7, 7^a, and 7^b; the contact fingers z, z', z^2 at the terminals of the wires e^2, e^3, f' are insulated from one another when the signal is at "safety" (Fig. 7) when the signal is at "danger" (Fig. 7^a) z, z' are electrically connected, and z^2 cut out, and when the signal is at "caution" (Fig. 7^b) z' and z^3 are electrically connected and z cut out.

The contact fingers z^3, z^4, z^5 at the terminals of the wires g', g^2 and h are insulated from one another when the signal is at "safety" (Fig. 7), when the signal is at "danger" (Fig. 7^a) the fingers z^3, z^4 are electrically connected and z^5 cut out and when the signal is at "caution" (Fig. 7^b) the fingers z^4, z^5 are electrically connected and z^3 cut out.

For the purpose of throwing the signal under the influence of gravity into an abnormal position in case of the breakage of the cord or chain which sustains its actuating weight, I find it desirable to make the caution and danger arms slightly heavier than the safety arm, so that—when left to itself—the signal will rotate backwardly, until it assumes a position with the safety arm upright and the danger and caution arms pointed obliquely downwardly. The signal as a whole will assume the position of an inverted Y with the safety arm upright.

Referring to the diagram, I have shown three sets of towers located consecutively along a single track, each set comprising two towers located upon opposite sides of the track. The first set is indicated by A, A′; the second set by B, B′ and the third set by C, C′. The towers themselves are represented conventionally by simply showing a shaft and indicating thereon the position of the signal arms, the spectacles and the circuit making and breaking disks and indicating in proximity to the shafts and its disks, the several electro magnets for releasing the signal operating shaft to set the different signals. In connection with these conventionally shown towers, I have indicated the electric circuits and relays in connection with the track circuit by means of which the following operations are accomplished as a train passes in either direction along the track:—First. Suppose the train to be moving in a direction from left to right, as the sheet containing the diagram is held, it will keep at all times three consecutive red or danger signals set in advance of it on the left hand side and will restore the danger signal in each tower, at the left hand side, as it passes it, to clear or safety; second, the said train as it passes each set of towers, will set the signal in the tower at the right hand side which the train is immediately passing, to danger, the signal at the previous tower on the right hand side from danger to caution and the signal at the second previous tower on the right hand side from caution to clear; third, although the signals are operated by the short circuiting of the magnets which operate them, as the train advances from tower to tower, the signals cannot be either carelessly or mischievously deranged by means of short circuiting from laying an electric connection across from rail to rail or by running a hand car along the track. The arrangement is such that the towers which serve the purposes of rear signaling, when the train is going in one direction, serve the purpose of header signals, when the train is coming in the opposite direction, and the header signals are set at such a distance in advance that under no circumstances can there be any excuse for two trains coming in an opposite direction approaching each other nearer than the distance of two consecutive towers.

The several operations hereinabove generally stated are accomplished in the following manner:—The several signals of the series, in the present example of my invention, are normally at safety and the relays which, by the movements of their armatures, control the changing of the signal at each individual tower from safety to danger; are in electric circuit through the rails of the track intermediate of two sets of towers and through gravity batteries S interposed in said track circuits; the relay of each individual tower on the right being in such track circuit with the relay in the next succeeding individual tower on the left. One of these normally closed main track circuits may be traced between the towers A′ and B as follows:—beginning at the pole of the battery S, toward the tower A′, along the rail t to the wire d' of tower A′

to the terminal y', at disk P', thence to terminal y at same disk, thence through b^2 to terminal x^4 at disk R, thence to either terminal x^5, x^6, thence through wire d or d^2 and d, through relays U', U at said tower A' to rail t', along rail t' to wire d or wires d and d^2, to terminals x^5, x^6, at disk R of tower B, through b^2 to terminal x^4 of disk P', thence to terminal y, at disk P', thence to terminal y', at same disk, thence through wire d' to rail t, and thence back to the opposite pole of said battery S. So far as these circuits are concerned, if the relay at either the individual tower on the right, or in the next succeeding individual tower on the left, be cut out of the said track circuit by a connection which enables the current to pass around said relay, such for example as a car truck on the track between the battery S and the relay in the tower at the right, or between said battery and the relay in the next succeeding tower at the left, the armature of such relay will drop and the signal at the tower will be released and permitted to change to danger. The said relay in each individual tower is, however, normally energized by a local battery in connection with the main track circuit which, until it has been cut out by the rotary movement of the disk R, located in the companion tower, as will be hereinafter fully described, holds the armature of the relay against dropping, no matter what may bridge the rails along the track between the battery S and the tower where the said battery s is located, and hence, an ordinary hand car for example, may be put onto and taken off the track at pleasure, and run along from block to block, without affecting the signals, unless it has gained control of them from the start by the energizing of the electromagnet Q^3 and the consequent movements of at least three of the disks R, one in each of three consecutive towers.

By the train dispatcher or by any suitable special arrangement at the beginning of the block system, the electro magnets Q^3 of the line wire circuit a for operating the header signals, have been energized to produce the following condition of things. The independently rotating disk R at the tower on the right which the train is about to pass, has been set free by the catch pawl r^3 under the control of the armature of the magnet Q^3 three times, or permitted to complete its rotary movement under the impulse of its actuating weight and in so doing has not only short circuited the relay U of the companion tower A through the circuit b, b', but has—in the course of its rotary movement—energized the magnet Q^3 of the next succeeding tower B' to release the disk R of that tower two steps, thereby short circuiting the relay U of the tower B and the rotary movement of the disk R of the tower B' has energized magnet Q^3 of the tower C', thereby releasing the disk R of that tower to move one step, closing the circuit b, b' and thereby short circuiting the relay U of the tower C.

The short circuiting of the relays U in the towers A, B and C above referred to, is effected specifically as follows: Take, for illustration, the towers B', B and A'; the movement of the disk R in the tower B' its first step has made electrical contact between the terminals of the wires b, b' at said disk R, and the normal circuit through gravity battery S, between towers A' and B, and through the relays and auxiliary batteries s of said towers, is now made to pass around the relay U of tower B. This circuit which cuts out the said relay U of tower B may be traced by beginning with the terminal of wire b, at disk R, of tower B', across the track, past relay U of tower B, to wire d, thence through auxiliary battery s of tower B to the terminal of a short connection b^2 between disks R and P', thence from the terminal of the short connection b^2, at disk P', by a suitable contact piece, to the terminal of the wire d' on the opposite side of the same disk P', thence through wire d' to rail t to one pole of battery S, between towers A' and B, from opposite pole of same battery, along rail, to wire d' of tower A', to the terminal of the wire d' at the side of the disk P' of said tower, thence through a suitable contact piece, to the terminal of the short connection b^2 on the opposite side of said disk, along said connection b^2, to its terminal at the side of the disk R, of said tower A', through said disk to the terminal of the shunt wire d^2 on the opposite side of said disk R, along said shunt wire d^2 to wire d of said tower A', thence through the relays U and U' of tower A', thence to rail t', along said rail to the wire b' of tower B', and thence to the terminal of said wire b' at the side of the disk R, of tower B', where it engages the contact piece on the disk which completed the circuit. Attention is called, at this point, to the fact that when the disk R of a tower rotates to make connection between the terminal of the wires b and b'; it, during its third or last step, breaks connection between the wire d of that tower through auxiliary battery s and the terminal of the short connection b^2, and makes connection between said short connection b^2 and the shunt wire d^2 which connects with the wire d between the auxiliary battery s and the relay U of that tower, and hence—after the disk R of any tower has been rotated its three steps, the auxiliary battery s of that tower has lost its control of the relay U of that tower until the said disk R shall have been returned to its normal position, and, in the mean time, the said relay U of that tower is subject to being short circuited by an electric connection, such as a car truck between the rails, at a point between the said relay and the gravity battery S which normally energizes it.

The movement of the disk R its second step, makes an electric connection on its face be-

tween the terminals of the line wire a and the ground connection a' through a local battery—for example—at tower A', and hence energizes the electro magnet Q^3 at the next succeeding tower B', the circuit being completed through ground connection a' of tower B', and this will advance the disk R of said tower B' its first step and thereby, in the manner above fully set forth, short circuit the relay U of the companion tower B.

The movement of the disk R of the tower A' its third step will—in like manner—again energize the electro magnet Q^3 of tower B' (there being a momentary break in the circuit, through line wire a after each closing of the circuit at each step of the rotary movement of the disk R) and as it (the disk R, at tower B') moves its second step it completes circuit through line wire a leading to electro magnet Q^3 of tower C' and thereby permits the disk R of said tower C' to move its first step to effect the short circuiting of the relay U of tower C.

The short circuiting of the relays U of the towers A, B and C on the left hand side of the track has had the effect, by dropping the armatures u of said relays, of breaking the electric circuits c, c', c^2, c^3 through the electro magnets Q', Q^2 of the towers A, B and C and by so breaking the said circuits, the signals in said towers A, B and C have been set to danger and the armatures u of the relays U in said towers A, B and C have been left open or in contact with the posts u^2 leading to ground.

The electric circuits c, c', c^2, c^3 may be traced as follows:—beginning with the terminal of the wire c^2, at the armature u, thence through electro magnet Q^2, thence—by wire c^2—to a yielding contact piece in permanent engagement with the armature of the pony relay U', through said armature, to the wire c', thence through electro magnet Q', thence through wire c and local battery s^3, to the armature at the point of beginning.

As the train passes the set of towers A, A' and bridges the rails of the track circuit at a point between the gravity battery S at the right of the set of towers A, A' and the towers themselves, it will short circuit the relay U of the tower A' by cutting out the battery S, the armature u of said relay will drop and the electro magnet Q' of the tower A' will be de-energized by the breaking of the electric circuit c c', c^2, c^3 and the signal of the tower A' will be set from safety to danger. In connection with this operation of short circuiting the relay U of the tower A', attention is called to the fact that the auxiliary battery s, which is located in the circuit d, d' through the relay U and the pony relay U', has been previously cut out by the last rotary movement of the disk R during the operation of setting the header signals heretofore described and the shunt d^3 around said auxiliary battery s has, by the same movement, been cut in; the disk P' forming an electric connection between the circuit wires d' and d^2 by means of suitable contact pieces.

The turning of the signal in tower A' from safety to danger has, by the engagement of the gears r and r', returned the disk R to its normal position, and in so doing, the electro magnet Q^3 of the next succeeding tower B' has been again energized and the disk R of the said tower B' has thereby been permitted to rotate its third and final step under the action of its operating weight and it in turn has, in the manner hereinabove fully explained, caused the disks R in each of the next two succeeding towers in advance to rotate one additional step, thereby dropping a header signal at the third tower in advance before the train leaves towers A, A'.

As the train passes along between the towers A, A' and its last truck passes from the track at the left of said towers, onto the insulated rails T at the towers, the battery S at the left of the set of towers will again energize the relay U of the tower A and thereby raise the armature u into position to close the circuit c, c', c^2, c^3. This return of the armature U will complete the following electric circuit between the tower A and the preceding tower on the right hand side of the track and including the battery s', in tower A', but which for convenience may be traced from tower C through tower C' and back to tower B', with the understanding that the effect produced at B' will be in fact the effect produced at the tower next preceding A' on the right, when the last truck of the train has passed onto the insulating track section T between the towers A, A' as above noted. Beginning with the ground connection e^4, at tower C, through a suitable contact piece on disk R of that tower to wire e, thence through the armature u of the relay U, of tower C, thence through wire e' and battery s' of tower C', to the face of disk P' of said tower C', through a suitable contact piece on disk P' to line wire e^2, thence back to a suitable contact piece on the disk P^2 of the tower B', thence to wire e^3, thence through electro magnet Q and wire g to ground, energizing magnet Q of the tower B' and thereby changing the signal of that tower from danger to caution.

The effect, which promptly follows the operation just described, upon the second tower to the rear, and on the right, may be traced from the tower B' back to the tower A' as though the latter were the second tower to the rear when the train has passed onto the insulated section between the towers A, A', as follows:—The turning of the signal in the tower B' from danger to caution closes contact between the terminals of the wires f and e^3 through the disk P' of said tower B', thereby completing the following circuit:—beginning at the terminal of the line wire e^2 at disk P', at tower B', back to disk P^2 at tower A', through a suitable contact piece on said disk P^2 to shunt wire f', thence to wire d at a point in-

termediate of the pony relay U′ and relay U of tower A′, cutting out the pony relay U′, thence through relay U and wire d to disk R of tower A′, thence—by short connection b^2—to disk P′, thence through a contact piece on said disk to terminal of wire d', thence to rail t through battery S to wire d' of tower B, thence to disk P′ of tower B, thence through disk P′ to short connection b^2, thence to terminal of wire d of tower B, thence to wire b leading from wire d to the tower B′, thence through wire b to wire f in tower B′ to the point of beginning.

The cutting out of the pony relay U′ of the tower A′ or second tower to the rear, permits its armature u' to fall into contact with the contact post u^3 and thereby cuts out the electro magnet Q^2 of that tower, permitting its signal to change from caution to safety. The circuit which cuts out magnet Q^2 may be traced as follows:—beginning with the terminal of wire c at the armature u, of relay U, tower A′, through battery s^3, through magnet Q′, through wire c' to armature u' of relay U′, through armature u' to post u^3, through wire f^2 to wire c^3, to armature u, leaving magnet Q^2 out of the circuit. The train now having first set the signal on its right at the tower which it is immediately passing to danger and then having set, in succession, the signal at the first tower to the rear from danger to caution and at the second tower to the rear from caution to safety, it remains to set the header signal at the tower which it is immediately passing from danger to safety, in order to complete the set of operations which take place at each successive set of towers. This last operation is effected as follows: As soon as the last truck has passed onto the insulated rails at the set of towers and thereby closed the armature u of the relay U of the tower A, the signal standing at danger in the tower A will be changed from danger to caution by the energizing of the magnet Q of the tower A. The energizing of said magnet takes place by the closing of the circuit leading from one pole of the battery s^2 in the tower A through the electro magnet Q and thence, by a branch wire g, to ground and from the other pole of said battery s^2, through a branch wire g', to a contact piece on the disk P^2; thence to another contact piece in electric communication with a wire g^2 leading to the armature u of the relay U; thence to a wire g^3, leading from said armature to one of the insulated rails; thence through the car trucks to the opposite insulated rail; thence through a corresponding wire g^3 of the tower A′; thence through a branch wire g^4, leading to a binding post or contact piece; thence through the armature u of the relay U, in the tower A′, to the contact post u^2 to ground. The connection between the branch wire g^4 and the ground contact u^2 is made only when the armature u of the relay U is open and, as has already been seen from the foregoing description, the said armature u of the tower A′ is open at this moment.

The movement of the signal in the tower A from danger to caution will be immediately followed by its movement from caution to safety through a short circuiting of the electro magnet Q^2 as follows:—The turning of the disk P^2 in the tower A as the signal is changed from danger to caution, cuts out the wire g' from electric contact with the wire g^2 and cuts the branch wire h into electric contact with the wire g^2; this will short circuit the electro magnet Q^2 of the tower A, the electricity from the poles of the battery s^3 of the tower A taking the following course: Beginning at the pole of the battery s^3 nearest the electro magnet Q′, the circuit will extend from the battery through the wire c to the electro magnet Q′ through said magnet to the wire c', thence through the branch wire h to the disk P^2; thence to the wire g^2; thence to the armature u of the relay U, in the tower A; thence to the wire g^3 to one of the insulated rails; thence through the car truck to the opposite insulated rail; thence to the corresponding wire g^3, to the wire g^4 and its contact piece; thence through the armature u of the relay U, of the tower A′ to a second contact piece, connected with a wire h'; thence through the wire h' to the wire c, back to the opposite pole of the said battery s^3.

The train, having set the signal in the tower A on its left to its normal position—safety—and having left the signals in the towers at the rear of it, on the right, at danger, caution and safety respectively; has fulfilled all of the operations required to insure its safety against interference, either from a train approaching it from in front or from the rear. As it reaches each successive set of towers, the several operations hereinabove described are repeated.

In the present system I have considered one of the magnets Q of the several towers as normally in an open circuit and the magnets Q′ and Q^2 as normally in closed circuits. Instead of this arrangement, the magnets may be normally in either open or closed circuit at pleasure, the change from one to the other requiring manipulation within the skill of any person expert in the subject.

What I claim is—

1. The signal system comprising series of signals, each series constructed to operate as header signals when a train is moving in one direction, and as rear signals when the train is moving in the opposite direction, and signal operating devices connecting the individual members of the series and interconnecting the members of the different series, and under the control of a moving train to set successively and maintain a plurality of signals of one series set in advance of the train as header signals and a plurality of signals of another series set to the rear of the train as rear signals, substantially as set forth.

2. The signal system, comprising series of signals, signal operating circuits under the control of a train, the train acting to cut out portions of said circuits, a main battery for each of said circuits and an auxiliary battery and circuit for controlling the signals when the main battery is cut out, and means under the control of the train for temporarily cutting out the said auxiliary battery from affecting a certain signal before the cutting out of the main battery from affecting that signal, substantially as set forth.

3. The signal system, comprising series of signals arranged in sets, the individual members of a set being electrically inter-connected, the one member of a set serving to control the setting of the signal of its companion to danger as a header signal when the train is running in one direction, said member being under the control of its companion to set its signal to danger as a header signal when the train is moving in the opposite direction, and electric circuits connecting the several sets of signals and under the control of the train to make and break them to maintain more than two of the signals of one series set in advance of the train as header signals and a signal of another series set to the rear as a rear signal, substantially as set forth.

4. A signal system, comprising series of signals arranged in sets, the individual members of a set being electrically inter-connected, and electric circuits connecting the several sets, the members of a set being each under the control of the other to set its signal to danger as a header signal, and each under the control of a passing train to set its signal as a rear signal, the members serving as header signals when the train is passing in one direction serving as rear signals when the train is passing in the opposite direction, and signal operating devices under the control of the train arranged to communicate with the third successive member of the rear signal series, in advance of the train, to set its companion member as a header, substantially as set forth.

5. A signal system, comprising a series of signals arranged at intervals along the track, a main track circuit including a battery for electrically connecting the successive signals, and under the control of a passing train to operate the signals, an auxiliary track circuit including a part of the main track circuit and a battery arranged to hold control of the signal independently of the battery of the main track circuit until the train shall have approached within a predetermined distance of the signal and means under the control of the train for cutting out the control of the said auxiliary track circuit as the train approaches the signal, substantially as set forth.

6. A signal system, comprising a series of signals arranged at intervals along the track, main track circuits including batteries for electrically connecting successive signals and under the control of a passing train to operate the signals, an auxiliary track circuit, including a battery for each one of the connected signals, arranged to hold control of the signal independently of the battery of the main track circuit, and electric circuits under the control of an approaching train to cut out the control of the said auxiliary track circuits as the train reaches points at predetermined intervals from the signals controlled by the auxiliary track circuits, substantially as set forth.

7. A signal system, comprising a series of signals arranged in sets of two along a track, the members of each set being electrically inter-connected, a main track circuit including a battery connecting the diagonally opposite members of each two successive sets and under the control of a passing train to operate the signals, an auxiliary track circuit including a battery for each individual member of the several diagonally opposite members arranged to control the signals of its own member independently of the battery of the main track circuit, and means under the control of an approaching train to cut out the battery of an auxiliary track circuit as the train approaches within a predetermined distance of the member at which the battery is located, substantially as set forth.

8. The signal system, comprising series of signals arranged in sets of two, electric connections between the members of a set and electric connections between a member of a preceding set and the diagonally opposite member of a succeeding set, a rotary circuit maker and breaker for each member, means for imparting to the said rotary circuit maker and breaker a step by step movement and electric connections between the successive rotary circuit makers and breakers whereby the movement of one rotary circuit maker and breaker will permit the movement of a succeeding rotary circuit maker and breaker, substantially as set forth.

GEORGE L. THOMAS.

Witnesses:
FREDK. HAYNES,
IRENE B. DECKER.