(No Model.) 5 Sheets—Sheet 1.

J. K. KNIGHT & W. H. BAKER.

ELECTRIC INTERLOCKING RAILWAY SIGNAL AND SWITCH SYSTEM.

No. 272,839. Patented Feb. 20, 1883.

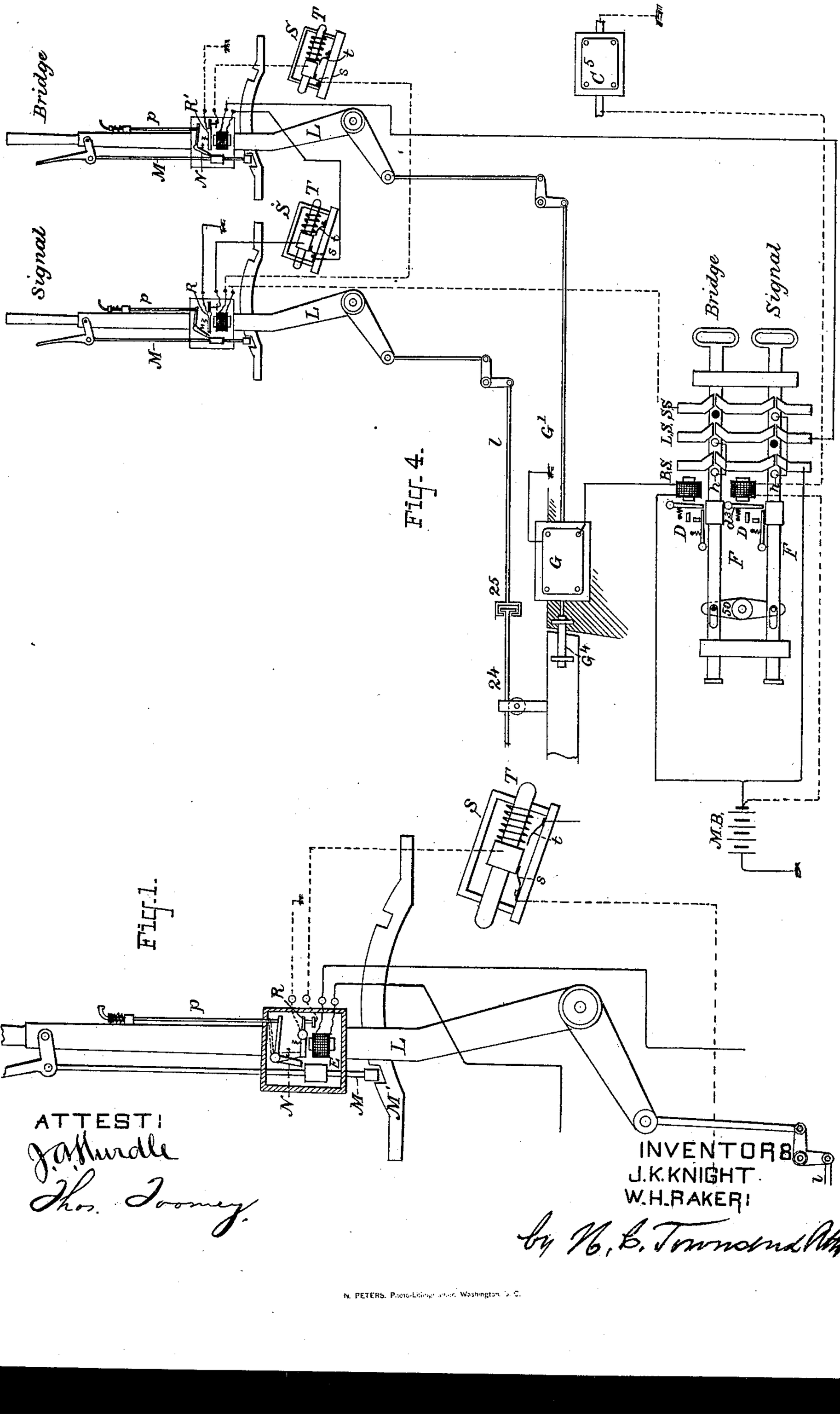

Fig. 1.

ATTEST:
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Thos. Toomey.

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(No Model.) 5 Sheets—Sheet 2.

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ELECTRIC INTERLOCKING RAILWAY SIGNAL AND SWITCH SYSTEM.

No. 272,839. Patented Feb. 20, 1883.

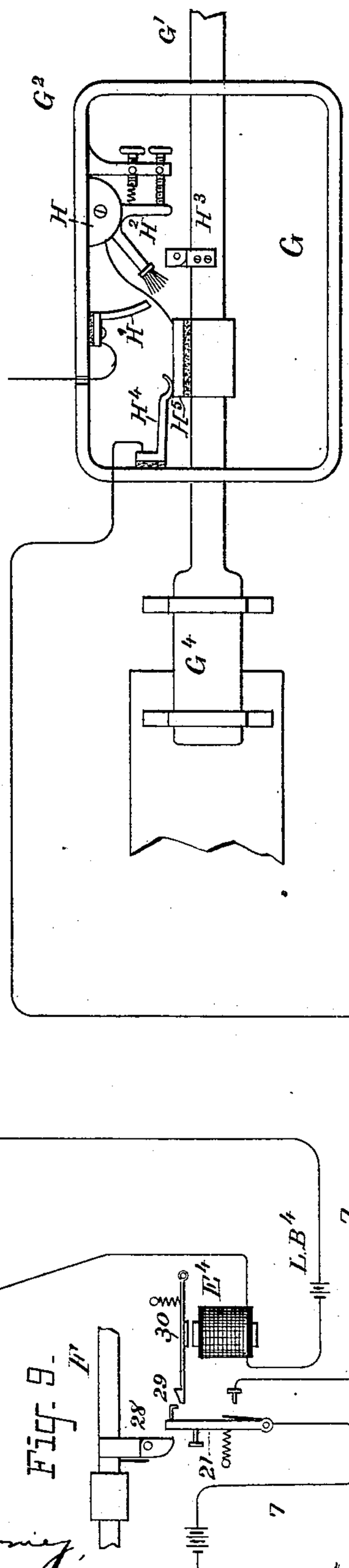

Fig. 2.

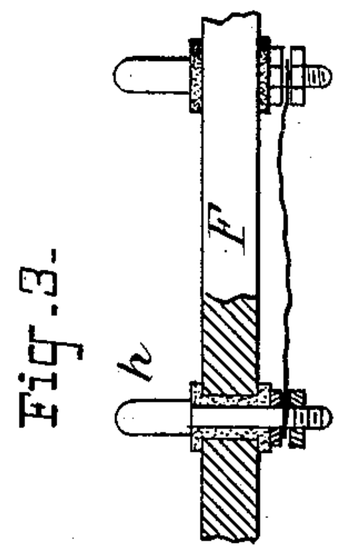

Fig. 3.

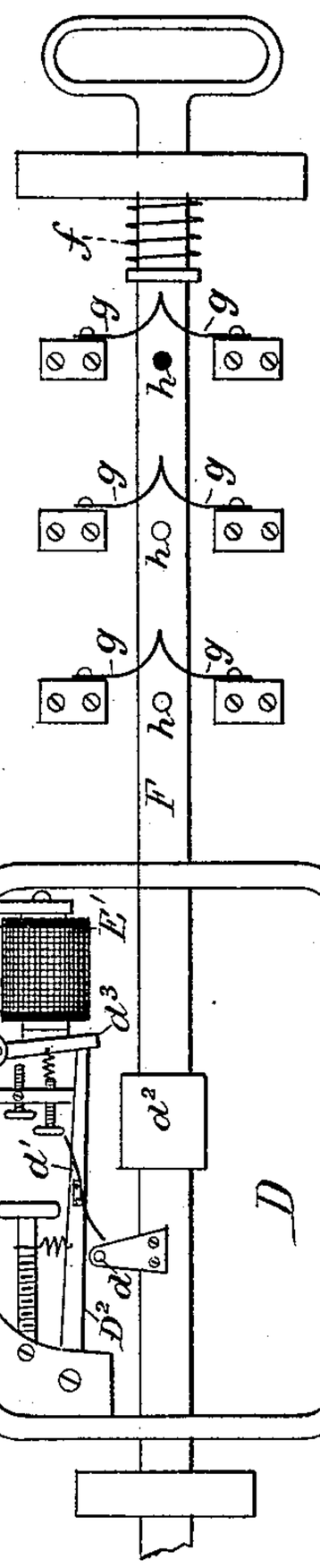

Fig. 9.

ATTEST:
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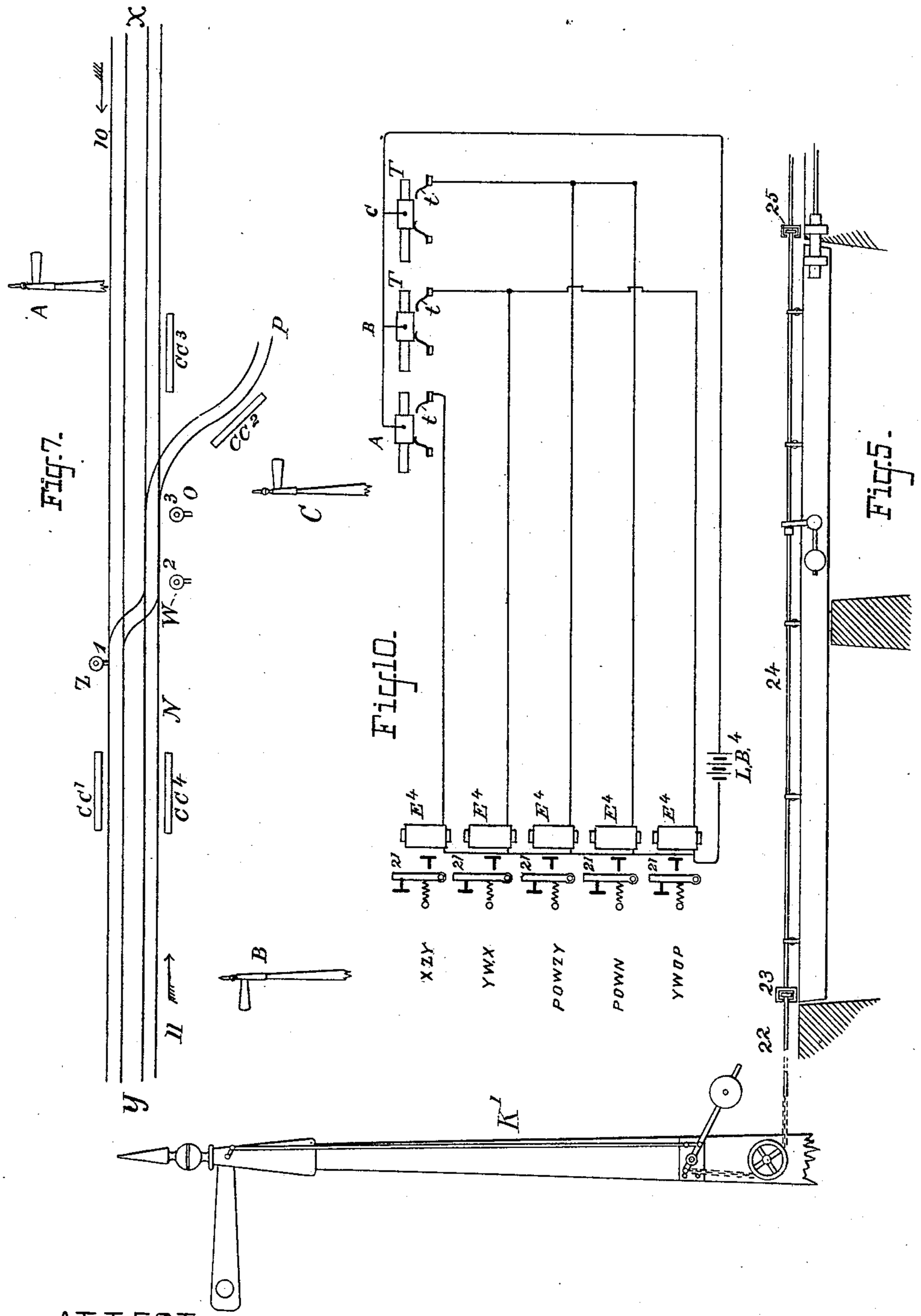
(No Model.) 5 Sheets—Sheet 3.

J. K. KNIGHT & W. H. BAKER.

ELECTRIC INTERLOCKING RAILWAY SIGNAL AND SWITCH SYSTEM.

No. 272,839. Patented Feb. 20, 1883.



ATTEST:
J. A. Thurdle
Thos. Toomey

INVENTORS:
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J. K. KNIGHT & W. H. BAKER.

ELECTRIC INTERLOCKING RAILWAY SIGNAL AND SWITCH SYSTEM.

No. 272,839. Patented Feb. 20, 1883.

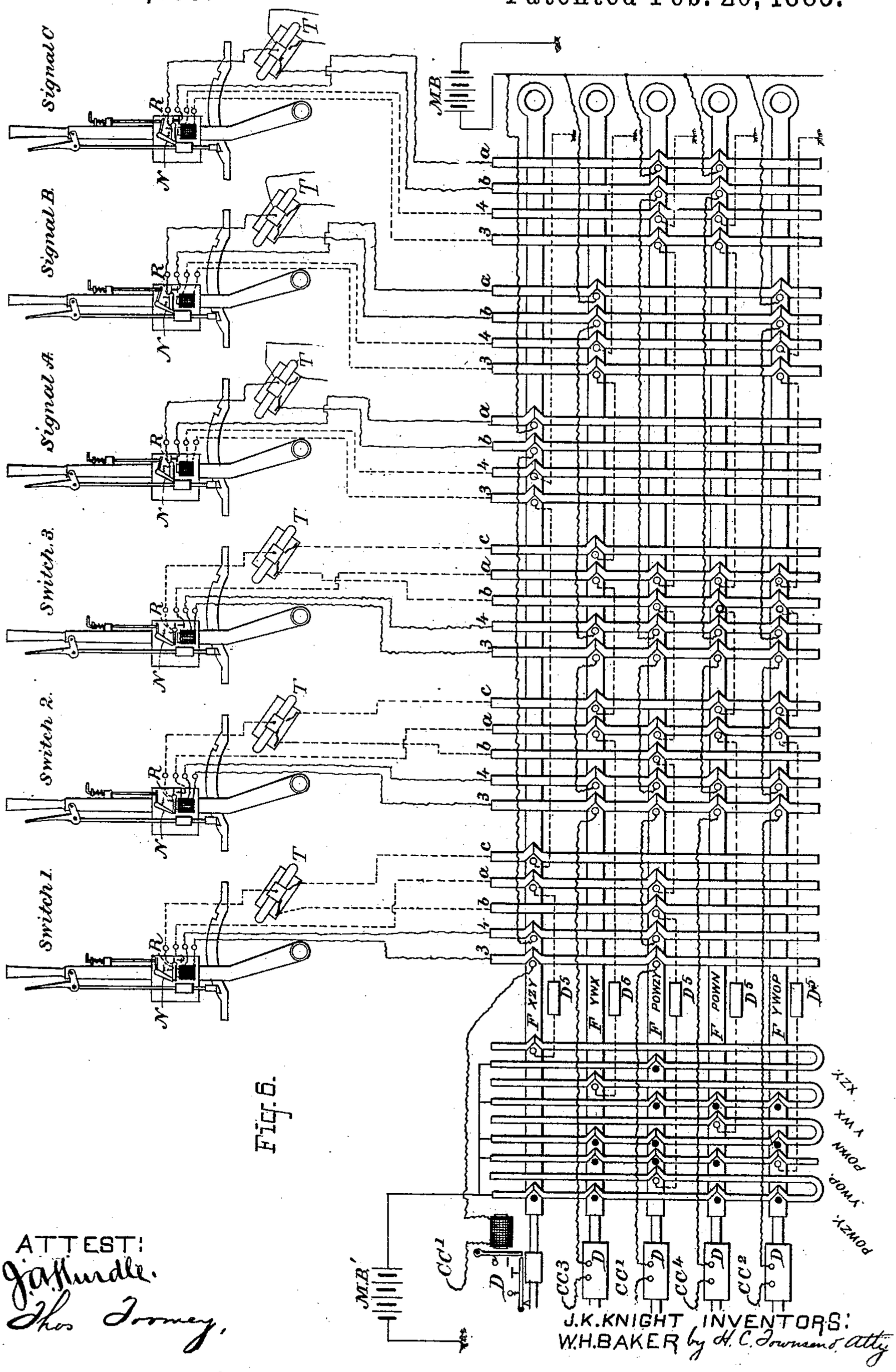

Fig. 6.

ATTEST:
J. Affundle.
Thos Toomey.

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N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.) 5 Sheets—Sheet 5.

J. K. KNIGHT & W. H. BAKER.

ELECTRIC INTERLOCKING RAILWAY SIGNAL AND SWITCH SYSTEM.

No. 272,839. Patented Feb. 20, 1883.

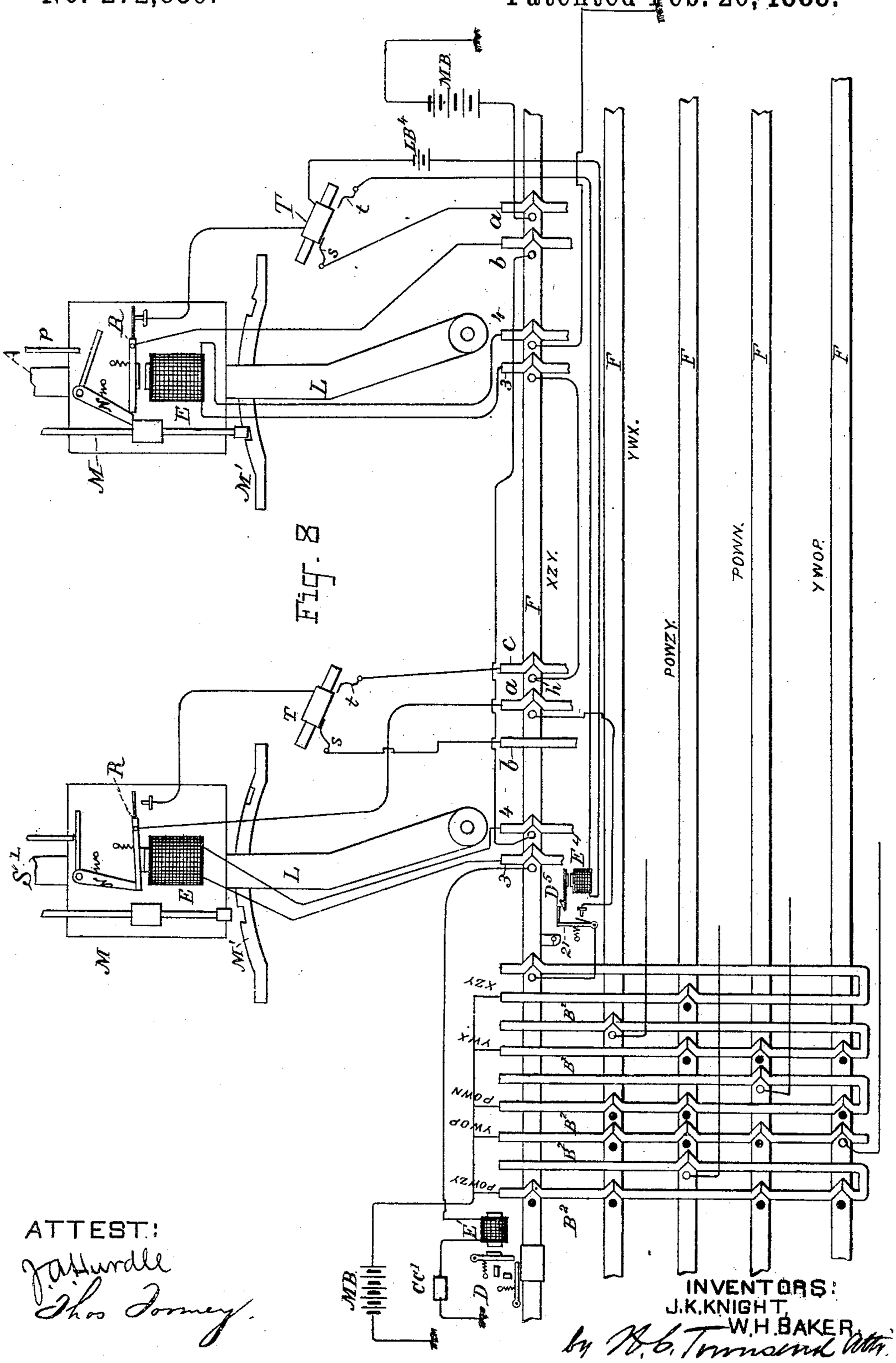

Fig. 8

ATTEST:
J. A. Hurdle
Thos Dorsey.

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UNITED STATES PATENT OFFICE.

JOHN K. KNIGHT, OF NEW YORK, AND WILLIAM H. BAKER, OF BROOKLYN, N. Y.; SAID KNIGHT ASSIGNOR TO SAID BAKER.

ELECTRIC INTERLOCKING RAILWAY SIGNAL AND SWITCH SYSTEM.

SPECIFICATION forming part of Letters Patent No. 272,839, dated February 20, 1883.

Application filed July 22, 1882. (No model.)

To all whom it may concern:

Be it known that we, JOHN K. KNIGHT and WM. H. BAKER, citizens of the United States, and residents respectively of New York, in the county of New York and State of New York, and of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Electric Interlocking Railway Signal and Switch Sytems, of which the following is a specification.

Our invention relates to electric railway switches or draw-bridges and semaphores or signals for indicating to an approaching train the condition of a switch or draw-bridge, combined upon what is known as the "interlocking" system.

The object of our invention is to provide a simple and effective substitute for the cumbrous mechanical devices heretofore employed for mechanically connecting and interlocking the operating mechanisms of the various switches and signals; and to this end we propose to employ in place of such mechanisms automatic locks controlled by electro-magnets, and manual electric switches controlling the circuits of said electro-magnets, in such a way that until the proper manual electric switch be set the desired railroad switches and signals cannot be operated, and while said manual switch is set conflicting railroad switches and signals are rendered incapable of operation, the electric connections through the portion of the manual electric switch for the latter being broken so long as the first-named switch remains set.

Our invention may be applied either to a single semaphore and its corresponding switch or draw-bridge lock, the combination being such that the manual electric switch corresponding to the semaphore breaks the circuit or battery connection of the electric switch for the railroad switch or draw-bridge lock, so as to prevent the improper operation of the latter, and, vice versa, the manual electric switch, which requires to be set when the railroad switch or draw-bridge lock is operated, breaks the connections for the manual electric switch of the semaphore, so that the latter cannot be improperly operated; or our invention may be applied to a number of switches and signals controlling the passage of trains at a depot or junction, the manual electric switches in this case being combined to constitute an electric route-switch, and arranged to each control the releasing electro-magnets for the railroad switches and signals requiring to be operated when a train is to pass over one of a number of routes, and to each break the battery-connections for the electric switches controlling all conflicting routes, so that the passage of the train over the route chosen cannot be interfered with, and trains upon conflicting routes cannot be signaled to proceed until the first-named electric switch has been reset.

Our invention consists, first, in the combination, with the operating mechanisms for the railroad-switches, railroad-signal, or draw-bridge lock, of electro-magnetically-controlled locking devices and a series of manual electric switches controlling the circuits of the locking or unlocking electro-magnets, said circuits being so arranged through the switches that the operation of any electric switch to release an operating mechanism will render the circuits for conflicting operating mechanisms inoperative. Under this head of our invention each electric switch controls not only the circuit of some one or more releasing device, and may be thrown to allow of the operation of such releasing mechanism, but also controls the circuits of all other releasing mechanism which should for the time being be rendered inoperative, so as to make it impossible by setting another electric switch to operate a conflicting railroad-signal or railroad-switch.

Our invention consists, secondly, in the combination, with some portion of the operating mechanism for a railroad-signal, railroad-switch, or draw-bridge lock, of electro-magnetically-controlled locking devices for said mechanism, a manual electric switch controlling the circuit for said locking devices, and an electro-magnetic locking device for the manual electric switch, controlled or released by means of a bridge-lock or a track-circuit closer.

Our invention consists, thirdly, of the combination, with the operating-levers of a number of railroad-switches and railroad-signals, of electric switches operated thereby, and provided with back and front electric contacts,

and suitable means for including the front contacts of the electric switches for those railroad-switches that should remain locked in their normal position and the back contacts of those which require to be operated in the releasing-circuit of the signals which require to be set in order to allow a train to pass over the desired route.

Our invention consists, fourthly, in the combination, with the two operating-levers for an electric railway-signal and for a railway switch or draw-bridge, of locking devices released by electro-magnets, and electric switches operated by said levers when thrown from the normal position, each such switch being arranged to control the circuit of the releasing-magnet of the lever which operates the other.

Our invention consists, fifthly, of a series of switch and signal operating mechanisms, electro-magnetic locking devices, manual electric switches, one for each desired combination of switches and corresponding signals, and circuit closers and breakers operated by each manual switch, and serving, when said switch is operated, to break the battery-connections for the releasing devices of the switches and signals of conflicting combinations.

Our invention consists, sixthly, in the combination, with the operating mechanism for a switch or draw-bridge lock and for a semaphore or signal indicating the condition of such switch or draw-bridge, of an electro-magnet acting to unlock such mechanism, and circuit-breakers actuated by said electro-magnets, and adapted, when the electro-magnet is energized for the purpose of unlocking one of said mechanisms, to break the circuit for the unlocking-magnet of the other of said mechanisms.

Our invention consists, seventhly, in the combination, with railroad switch and semaphore operating mechanisms, of releasing electro-magnets and a manual electric switch acting upon circuit-closers which serve to connect the releasing electro-magnets for the semaphores to a battery through electric switches controlled by the railroad-switch mechanisms, and simultaneously to connect the releasing electro-magnets for the railroad-switches to a battery and track-circuit closer, all being arranged in the manner hereinafter set forth, so that the signals cannot be set to allow the trains to pass until the railroad-switches have been set and locked in the proper positions, and the latter cannot be unlocked and reset until the train, by passing the track-circuit closer, energizes their releasing-magnets.

Our invention consists, eighthly, in combining with the releasing electro-magnets for railroad switch and semaphore operating mechanisms a manual electric switch provided with an automatic lock and releasing electro-magnet for the same, and arranged to act upon circuit-closing devices in such a way as to complete a circuit from an electric battery to the releasing-magnets of the signals through circuit-closers controlled by the switch-operating mechanism, and to simultaneously connect the releasing electro-magnets for the railroad-switches and the electric switch to a track-circuit closer, all as hereinafter more fully set forth.

Our invention consists, ninthly, in the combination, with the manual electric switches that control the circuits for the locking devices of the railroad signals or switches, of mechanical devices adapted to prevent the operation of any conflicting electric switch while another conflicting electric switch is set.

Our invention further consists in certain combinations and certain details of construction and arrangement that will be specified in the claims.

In the accompanying drawings, Figure 1 shows one construction of operating-lever and its connected electro-magnetic locking devices and circuit-closers that may be employed in carrying out our invention for operating the railroad switch, semaphore, or draw-bridge lock. Fig. 2 shows a plan view of one portion of the manual electric switch and an automatic locking device applied thereto, and also shows the construction of a circuit-closer employed, in conjunction with a bridge-lock, for momentarily closing an electric circuit when the bridge-lock is set to lock the bridge, the function of which circuit is to automatically release the manual electric switch. Fig. 3 is a partial longitudinal section of one of the electric switch-bars, showing the manner of mounting and connecting the circuit-closing studs employed with the form of switch herein shown. Fig. 4 is a diagrammatic view illustrating the application of our invention to a railroad draw-bridge lock, and the operating mechanism for the semaphore-signal, used to indicate to approaching trains the condition of the bridge. Fig. 5 shows the draw-bridge and the semaphore, with the means employed for connecting the semaphore, with its operating mechanism placed upon the opposite side of the bridge. Fig. 6 illustrates diagrammatically the application of our invention to the switches and signals for the junction of a branch line with a double-track road such as is indicated in Fig. 7. Fig. 8 shows in enlarged plan the manner in which the semaphore and switch mechanism for one of the routes at the junction are combined and operated, as also the manner in which each bar of the route-switch breaks the releasing-circuits of all conflicting routes. Fig. 9 is a detail view of an automatic circuit making and breaking apparatus employed with each bar of the route-switch for completing the releasing-circuit of the semaphore-levers when the switch-bar is set, and for automatically breaking such circuit when the semaphore mechanism has been operated. Fig. 10 is a diagram of the local wires of the automatic circuit breakers, Fig. 9, as applied to the complete switch.

Referring to Fig. 1, L indicates an ordinary form of operating-lever connected through links and bell-crank levers with a rod, *l*, by which movement is transmitted to a railroad

switch or draw-bridge lock, while M indicates the catch-rod for such lever, which serves, when engaged with a segment-bar, M′, to hold said lever in either of two positions in a well-known manner.

E represents an electro-magnet, whose armature, when retracted against its back-stop so as to occupy the position shown, acts to hold or detain a pivoted locking-stop, N, in engagement with a projection or shoulder upon the catch rod M, so as to prevent said catch-rod from being withdrawn from the locking-segment M′. When, however, the electro-magnet attracts its armature, so as to carry it away from the line of movement of the locking-stop N, a retracting-spring or other suitable retracting device applied to the latter immediately withdraws it from its locking position for the catch-rod, so that said catch-rod can be lifted and the switch, draw-bridge lock, or semaphore operated. The lock N and armature-lever then assume the position shown in dotted lines, in which position the armature-lever is locked against its front stop and must retain the position shown, although the circuit of the electro-magnet may be broken, until the lock N is removed from behind it into position where it will engage with the shoulder on the catch-rod, this operation being effected by what we term the "locking-rod" *p*, which can be brought into engagement with the horizontal arm of the lock N, so as to move it from behind the armature into locking position with relation to the catch-rod. When this is done the armature, provided no current be flowing in electro-magnet E, will fall against its back stop and detain or hold the lock N in locking position until the armature be again attracted.

It will be noticed that the parts are so disposed with relation to one another that the locking-lever N cannot be placed in position where it will lock the catch-rod, excepting when said catch-rod is fully depressed, so as to lock the operating-lever L, the collar or enlargement on the catch-rod being in its way, and that as a consequence the armature of electro-magnet cannot be allowed to recede until said operating lever L is locked. The electro-magnet E also serves, through its armature, to operate a circuit-controlling device, R, consisting, as here shown, of an ordinary circuit closer and breaker, formed by a contact-stop, against which the armature, or an extension therefrom, impinges whenever the lever is retracted, contact being, however, broken whenever the armature-lever is attracted, and remaining broken so long as the lock N holds the armature against its front stop. By this arrangement the circuit is broken whenever the catch-rod M is released, and must remain broken until said rod is restored to its normal position, so as to lock the operating-lever L, because in no other position of the catch-rod can the lock N be removed from behind the armature. So long, however, as the catch rod and operating-lever are locked the circuit is closed, provided no current flows through the coils of electro-magnet E.

At S is shown another circuit-closer in circuit with R, which is moved into one position by the lever L when the latter is thrown to its extreme right-hand position, and returns to its normal position, by the action of a spring or other suitable device, when the lever L is moved to the left. T is the reciprocating rod of said circuit-closer, mounted and moving in suitable bearings, and projecting at its left-hand end into a position where the lever L will come into engagement with it and force it back against the action of a spiral spring applied in the manner shown.

Circuit-closing springs *s t* are mounted in any suitable manner upon and insulated from the casing or supports for the rod T, and are arranged so that in the normal condition of the parts a circuit-closing projection on the rod T will make contact with the spring *s*, which we shall, for the sake of convenience, term the "front contact" of the switch, the connection with the back contact-spring, *t*, being then broken. When, however, the lever L is thrown to the right the rod T is operated and the front contact is broken, the back contact, *t*, being then closed.

The rod T or some other portion of the device electrically connected therewith is electrically connected in any suitable manner with the circuit-closer R, which latter we shall, for convenience, term the "lock-circuit closer," the circuit-closer S being the operating-lever circuit-closer.

In Fig. 2, F indicates one of the switch-bars of the manual switch, mounted in suitable bearings, so that it can be moved longitudinally against the action of a spiral spring, *f*, or other suitable retractor, which tends to hold it in the position shown in the drawings.

Arranged in proximity to the bar is a series of pairs of circuit closing springs, *g g*, mounted in any suitable manner, between which springs studs or projections *h h h* upon the bar F are carried when the bar F is pulled out. The studs *h* are either conducting or circuit-closing studs, or they are of insulating material, so that they act in the one case as the means of closing a circuit between a wire connected to one or the other of the springs *g g* and any suitable wire connected to a conducting-stud, and in the other to break the connection between a pair of springs *g g*, thus interrupting any circuit which is normally completed by them. The right-hand stud *h* of the three (indicated in solid black) is a circuit-breaking stud, while the other two are circuit-closing studs. The latter are mounted and constructed in the manner shown in Fig. 3. Each consists of a pin passing through the bar F, from which it is insulated by a sleeve of hard rubber or other suitable material.

Clamping-nuts upon the lower end of the pin serve to clamp any electrical conducting-wire thereto.

In conjunction with the switch-bar F is em-

ployed an automatic locking and releasing device, D, which holds the bar in position where the proper circuits are closed, and automatically releases it when the proper circuit is closed by the passage of a train over any suitably-constructed track-circuit closer, or by a circuit-closer operated in the act of locking a draw-bridge.

D^2 indicates the locking-lever, which, when the bar is pulled out, is brought into locking position behind a shoulder or projection, d^2, upon the bar by means of a pin connected to the bar, and indicated at d, which pin passes behind an inclined spring, d', upon the locking-lever. When brought to this position the locking-lever is held by an armature, d^3, of an electro-magnet, E′, which is retracted by means of a spiral spring or other device, and by falling back behind the end of the locking-lever D^2 prevents the latter from being withdrawn by the action of a retractor applied to said locking-lever until the circuit of the electro-magnet is closed and the armature is drawn forward out of the path of the locking-lever. Whenever this occurs the bar F, being released, is returned to its normal position by the action of its spiral spring f, the pin d in this case passing along the inner side of the spring d' until it escapes by the end of said spring, when the parts assume the position shown in the drawings.

A bridge-lock-circuit closer is shown at G, and in the present case is connected to the electro-magnet E′. The bridge-lock bolt is indicated at G^4, and the operating-rod connected to a suitable operating-lever—such, for instance, as that shown in Fig. 1—is indicated at G′. The circuit-closer operated by the rod G′ is contained in a casing, G^2, through which the rod G′ passes.

H indicates a swinging circuit-closer, having a circuit-closing arm which is adapted to make contact with a curved contact-plate, H′, and an operating-arm H^2, arranged in the path of an operating-latch, H^3, which engages with and swings the circuit-closer when the rod G′ is moved so as to lock the bridge, but slips by said arm H^2 when the rod G′ is moved so as to unlock the bridge.

H^4 indicates a circuit-closing spring insulated from the casing, and arranged to make contact with a contact plate, H^5, upon the rod G′ only when the bridge-lock is set completely so as to lock the bridge. The connections are, as indicated, from the releasing electro-magnet E′, connected to one pole of a battery, whose other pole is grounded, to the contact-spring H^4, from contact-plate H^5 to swinging circuit-closer H, and from contact-plate H′ to earth. When the parts are in the position shown and the bridge locked the circuit is broken at contact H′. When the bridge is unlocked the circuit is not completed, because the latch H^3 does not operate the circuit-closer H, and the contact at H^4 H^5 is broken. When the bolt is thrown to lock the bridge the latch engages with the circuit-closer, causing it to sweep over the plate H′; but the circuit is not completed until the contact at H^4 is closed, at which time the latch escapes by the end of the operating-arm H^2, and the retracting-spring applied to H^2 thereupon restores the circuit-closer H to the position shown, the circuit being closed while H sweeps back over the plate H′.

In Fig. 4 is shown the manner in which the parts already described are applied to carrying out our invention in connection with a railway draw-bridge and semaphore.

The manual switch contains two switch-bars, F, that which requires to be operated when the semaphore is to be set to allow a train to pass being indicated by the word "Signal," and that which requires to be operated when the draw-bridge is to be opened being indicated by the word "Bridge." Each manual switch-bar is provided, as shown, with the automatic locking and unlocking devices described in connection with Fig. 2, the releasing electro-magnet for the bridge switch-bar being connected to a circuit-closer, G, similar to that already described, and the releasing electro-magnet for the signal switch-bar being connected to a track-circuit closer, C^5, of any well-known construction adapted to be operated by the passing train after it shall have passed over the draw-bridge.

M B indicates the main battery, which supplies the current for operating the various unlocking electro-magnets, and B S a battery-strip connected to one pole thereof, which in practice would consist of pairs of circuit-closing springs g g, Fig. 2, connected in series and arranged one pair over each switch-bar F and in line with a circuit-closing stud, h h, such as is shown in Fig. 2, but is for simplicity indicated as a continous strip of metal split or divided at points in line with the stud h. S S is a similar strip, one end of which is connected to the releasing electro-magnet for the lever L, which serves to operate a track semaphore or signal, which lever is distinguished by the word "Signal;" and L S is a third strip, connected, as shown, with the releasing electro-magnet of a lever which operates the bridge-lock.

On the signal switch-bar F is a circuit-closing stud in line with the strip S S, and electrically connected with the circuit-closing stud upon said bar, which makes contact with the battery-strip B S, so that when the bar is pulled out the releasing electro-magnet for the signal is connected to the battery. Upon the bridge switch-bar F is also a stud, which in a similar way connects the releasing electro-magnet for the bridge-lock lever with the battery-strip and the battery. Each switch-bar F also carries a circuit-breaking stud, as shown, arranged in proper position to break the circuit of the strip through which the other completes the circuit between the battery-strip and the wire leading to a releasing electro-magnet.

The signal-lever L is connected to a properly-biased semaphore, arranged to normally indicate "danger" when the lever is in its normal position, which is the position shown in the drawings. In the position of the bridge-lock lever indicated the bridge is locked. The switches and the locking apparatus are normally in the position indicated, the catch-rods of both levers being locked. The circuit of the releasing-magnet for the signal-lever is normally closed to earth, as shown, through the front contact of the electric switch or circuit-controller S, which is operated when the bridge-lock lever is thrown; and through the switch R′, controlled by the releasing electro-magnet for said lever. In a similar way the releasing electro-magnet for the bridge-lock lever is normally connected to earth through the switches S and R, used in conjunction with the signal-lever. The circuits of the releasing electro-magnets for the switch-bars are broken at the circuit-closers G and C^5, the signal is at "danger," and the bridge locked. Let it be supposed that an approaching train is to be signaled "safety." The signal switch-bar F is pulled out and locked by the lock-lever of D and armature d^3. In pulling out the bar the operator completes a circuit for the main battery through the releasing electro-magnet of the signal lever, so that the lock of the catch-rod for that lever is withdrawn, while the armature of the releasing electro-magnet, being attracted, breaks the circuit of the releasing-magnet for the draw-bridge-lock lever, so that the latter cannot be unlocked, even though the manual switch-bar should be pulled out.

It is to be also observed that the armature, having been attracted, will be held in locking position by the lock for the catch-rod springing behind it, and that it can only be released to close the break in the circuit of the releasing electro-magnet for the draw-bridge lock by the operation of the locking rod *p*. The operation of the signal switch-bar F also, as will be evident, breaks the circuit for said releasing-magnet in the switch-strip L S, so that if the bridge-bar F should be pulled out it would not operate to perform its ordinary function of closing the circuit from the battery to the wire leading to the releasing electro-magnet for the bridge-lock lever. The signal lever, being thus unlocked, may be used to set the semaphore to "safety," the draw-bridge lock being in the meantime incapable of operation. In throwing said lever to "safety" position the lever-switch S is also operated, so as to also break the circuit for the releasing electro-magnet of the bridge-lock lever. The purpose of this will be stated presently. The train, having passed the bridge, operates the circuit-closer C^5, thus completing the circuit for the releasing electro-magnet of the signal switch-bar F, which latter thereupon returns to its normal position. Signal-lever L is now returned to its normal position and the locking-rod *p* operated so as to cause the lock to engage with the catch-rod, in which position it is held by the armature of the releasing electro-magnet, whose armature is now at liberty to drop back, the circuit of said magnet having been broken by the return of the switch-bar F.

It would of course be possible for the operator to leave the catch-rod unlocked in "danger" position of the signal; but he cannot release the bridge-lock lever until he has locked it in that position, since, if he should throw the lever back to "safety" position and lock it there, the circuit of the releasing electro-magnet for the bridge-lock would then be broken at the contact of the switch S. It is therefore necessary for the operator to set and lock the signal-lever at "danger" before he can operate the bridge-lock lever, although it would be possible for him to leave said lever unlocked in "danger" position, ready for signaling "safety" to the next train, without operating the manual switch-bar, or he might work the lever for the purpose of oiling. In the same manner the bridge-lock lever may be operated for the purpose of unlocking the bridge, its manual switch-bar having first been pulled out and automatically locked and the signal-lever having been set and locked in the "danger" position, as just explained. The bridge being unlocked, the signal-lever cannot be operated, its releasing-circuits being broken in precisely the same manner as first explained with reference to the releasing-circuits of the bridge-lock, nor can said signal-lever be operated until the bridge is closed and the bridge-lock lever reset and locked in position where the bridge is locked. In operating the bridge-lock to unlock the bridge the circuit-closer G is not affected, so that no effect is produced upon the releasing electro-magnet for bridge-bar F; but when the bridge-bolt is set home in locking position the circuit is momentarily closed in the manner already explained, and the manual switch-bar is allowed to recede to its normal position.

In the present application of our invention the front contacts only of the circuit-closers T are employed. In practice the circuit to earth through the bridge-lock-circuit closer should be completed through a suitable circuit closer or closers, one part of which would be upon the draw-bridge itself and the other upon the stationary sill, and which would be so arranged as to complete the circuit only when the draw-bridge is completely closed. By this means it is impossible for the operator to reset the locking-bolt and restore the parts to a position in which the signal could be operated before the draw-bridge is completely closed.

As an additional measure of precaution to prevent the operation of one switch-bar, F, while the other is set and locked, we may employ the mechanical device shown, consisting of the pivoted lever 50, having pins which engage with the bars by passing into elongated slots in said bars of sufficient length to allow either bar to be pulled out to its full distance without interference from the other. Fig. 5

shows how motion may be communicated from a signal-lever to a semaphore placed on the opposite side of a draw-bridge, the construction being such that mechanical connection with the biased signal is broken so long as the draw-bridge is open. Said signal for this reason also must remain at "danger" until the bridge is closed.

K′ indicates an ordinary biased semaphore, connected to a rod, 22, mounted in suitable supports at the side of the bridge, and provided at its end with a coupling flange or head, which is embraced by a coupler, 23, when the bridge is closed. The coupler 23 is at the end of a rod, 24, mounted in suitable bearings, and extending from one end of the bridge to the other. At the opposite end of the rod 24 is a similar coupling device, which, when the bridge is closed, completes the mechanical connection to the rod 25, connected to a signal-lever of any suitable kind. When the bridge is opened the couplings are disconnected, the two elements being displaced laterally, and the semaphore cannot be operated, but remains at "danger," being properly biased, or provided with a suitable counterweight for that purpose.

Suitable stops are provided for limiting the movements of the rods so that the parts of the couplings may engage when the bridge is closed.

Fig. 7 is a diagram showing the junction of a double-track road with a branch line of a road. At this junction there are five routes or paths that may be taken by trains on the main road and the branch, which it is the purpose of the arrangement of switch and signal operating levers and manual route-switch shown in Fig. 6 to properly protect from collisions. Three switches, 1 2 3, are employed for the purposes of allowing trains to take the route from the branch track to the main track 10, or from the main track 11 to the branch. The five routes, each of which requires a different arrangement of said switches, are as follows, the path being indicated by letters placed at different positions of the route: route X Z Y on track 10, which requires switch 1 to be set to the main track, and which is a conflicting route for trains coming from the branch track to the track 10; Y W X, which requires that switches 2 and 3 should be set to the main track, and conflicts with route for trains, as in the case of X Z Y, and also with the setting of the switches and signals for trains on routes Y W O P and P O W N; P O W Z Y, which conflicts with all the other routes, and requires that switches 1, 2, and 3 should be set away from the main tracks. P O W N is the route of trains coming from the branch to the downtrack 11, and which conflicts with trains coming in the opposite direction, and which requires that switch 2 should be set to the main track, and switch 3 first to the branch track and afterward to the main track; Y W O P, which conflicts with the setting of the signals and switches for all other routes excepting the route X Z Y. The semaphore-signals for trains approaching the junction on the three different tracks are indicated at A B C, and are normally at "danger." For each of the five routes mentioned one or the other of said signals requires to be set to "safety," the signals of all conflicting routes being at that time locked at "danger," although the signal for routes which do not conflict should be left free, to be controlled by the proper manual switch, as will be presently explained.

It is also necessary, of course, that the switches for any one route should be incapable of being set for a conflicting route until after the train has passed the route desired.

For each of the routes mentioned we employ a separate manual switch-rod, F, which serves to complete a controlling or releasing circuit for the signal requiring to be operated, and which controlling-circuit includes also switches and circuit-closers or circuit-controllers conjoined with the switches on such route in such a way that the releasing-circuit of the signal will be completed only when the switches requiring to be operated have been operated and locked and the switches that must remain in normal position have been locked in such position. Each switch-bar is so arranged as to not only complete the proper circuits for its route, but also to break the circuit-connections for the bars of the conflicting routes. In addition to the signal-releasing circuit, each bar completes a circuit, whereby the releasing-magnet of the bar itself may be energized by the operation of the train upon a suitable circuit-closer so operated by a train, after it has passed the switches of the route, as to allow said bar to return to its normal position, said releasing-circuit including also releasing electro-magnets which allow the switch-levers to be reset to their normal position.

The manner in which a single route-switch acts in conjunction with its corresponding signal and track switch is shown in Fig. 8, as also the manner in which each route-switch acts to break the connections of the releasing-circuits for all the conflicting switch-bars. The switch-bar for each route is indicated by the combinations of letters already used, and the connections of switch-bar X Z Y are shown.

M B′ is the main battery for the signal releasing and controlling circuits, and M B the battery for the switch bar-releasing magnet, and for the magnets used in conjunction with the locking mechanisms for the railroad-switches. Battery M B′ is connected at one pole with a series of battery-strips—one for each route-switch bar—through which strips the controlling-circuits for the signals are completed by means of contact-studs *h*, like those already described, said studs—one on each bar—making contact with a strip when the bar is pulled out, and being themselves suitably connected with other contact-studs, to be presently referred to, by which the proper connec-

tions with the releasing-magnets for the signals, and with the electric switches, combined with the switch-operating mechanisms, may be made.

The battery-strips B^2 for the several switch-bars are indicated by the corresponding combinations of letters.

In addition to a contact-stud, *h*, each switch-bar carries one or more circuit-breaking studs, (indicated in solid black,) the function of which is to cause a break in the battery-strips of the switch-bars of all conflicting routes at some point between the battery and the points where the contact-studs of such bars make connection. By examining the diagram it will be seen, for instance, that bar P O W Z Y has four insulating-studs, each of which acts upon bars of the battery-strips for the four conflicting routes, and that bar X Z Y has but one circuit-breaking stud, which acts only upon the strip P O W Z Y, that being the only conflicting route. By tracing the connections the same action will be seen to take place whenever any switch-bar is pulled out.

S′ and A indicate respectively the railroad-switch lever and the signal-lever corresponding to route X Z Y, each being equipped with the locking devices and switches already described in connection with the draw-bridge signal. They are connected to one another and to the switch-bar in the following manner: Their releasing-magnets, as shown, are connected to contact-springs 3 4, with which contact-studs upon the switch-bar are adapted to make connection. The contact-studs corresponding to the switch-lever S′, as shown, make contact, one with the releasing electro-magnet for the switch-bar F and the other with a contact-stud which serves to complete a connection to the switch R of A, its fellow stud completing a connection between the front contact of the switch T at A and the main battery M B′. As will be seen, when the switch R is in proper position the operation of the switch X Z Y will complete the connection between the battery M B and the switch-bar, releasing electro-magnet E′ through the lock electro-magnet of the railroad-switch lever S′, so that when the train passes a track-circuit closer, C C′, Fig. 6, placed at the point indicated, and connected to the electro-magnet E′, (the switch-bar being drawn out,) the electro-magnets will be energized, the bar released, and the catch-rod for switch-lever S′, if it be locked, will be simultaneously released.

The releasing-circuit for the signal A is through the battery-strip X Z Y when the switch-bar is drawn out through a device at D^5, (the operation of which will be presently described,) through a connection, *a*, for switch-lever S′, the switch R when the lock-releasing armature for S′ is released, back contact, *t*, of switch T when the lever S′ is thrown over so as to operate switch T, back-contact connection C, stud *h* making contact therewith, and thence to and through the releasing electro-magnet for signal-lever A by a wire connecting the latter stud with the stud contacting with the spring 3 at A, and to earth.

The front-contact connection *b* for switch T is not affected by the operation of the bar X Z Y, although it is by the operation of other switch-bars whose routes require that the switch S′ should remain in the position shown, as will be seen from Fig. 6.

By the completion of the circuit just described the catch-rod of signal-lever A is released in a manner that will be readily understood from what has been already said as to the operation of such device in connection with Figs. 1 and 4.

The apparatus at D^5 serves to complete the releasing-circuit for the signal-lever when the switch-bar is pulled out, and to automatically break said circuit when the signal-lever is thrown over and there is no further work to be done by said circuit. Its construction and connections may be seen in Fig. 9 detached from the other parts. The releasing-circuit controlled by it is indicated by the number 7, while 21 is a circuit closing and breaking lever for said circuit, the end of which is arranged in the path of an operating-latch, 28, on the switch-bar F, said latch being suitably constructed to engage with the lever when the bar is pulled out, and to pull the lever forward into a position where it will close the circuit 7, in which position the lever is temporarily locked by means of a hook, 29, which engages with the catch upon the end of the armature-lever 30. The latch does not swing in this operation, but slips past the end of lever 21 after the lever has been turned sufficiently to close the circuit and be locked. In its return movement, after the lever has resumed its normal position, the latch turns, and thus allows the rod F to freely take the position shown. The lever 21 is released by the electro-magnet E^4, the circuit of which, through a local battery, L B^4, is closed by the back contact, *t*, of a switch, T, placed in the path of the signal-operating lever A, as shown in both Figs. 8 and 9.

The operation of the apparatus as shown in Fig. 8 is as follows: In the normal position of the switch-lever S′ the switch is set to the side track, but the lever is unlocked, the lock N being in the position shown, so that the electric switch R is opened. The signal-lever A is normally locked, as indicated, and the semaphore A is at danger. To allow a train to pass over the route X Z Y, switch-bar for X Z Y, Fig. 8, is pulled out, the effect of which is to close the breaks in the releasing-circuit for A at stud *h*, and battery-strip for said bar, circuit-closer D^5, switch-connections *a c* for the switch-lever S′, and connections 3 4 at signal-lever A. Breaks in such circuit exist at switches R T of the switch-lever S′, which can only be closed by first throwing the switch-lever so as to put the switch to the main track and operate circuit-closer T, and by then locking the switch in that position, so as to close

the break at R. Signal-lever A is thus released, and switch-lock N for signal A locks electric switch R, so as to break the circuit of the releasing-battery M B at that point. Signal A is then set to "safety," this act operating the switch T so as to cause a break in the circuit of releasing-battery M B at the front contact of said switch, and at the same time to complete through its back contact, *t*, the circuit of electro-magnet E^4, thus releasing switch D^5 and causing the releasing-circuit from M B′ to be broken. So soon as the locomotive of the approaching train passes signal A it is the duty of the operator to immediately reset signal A to "danger," and to lock it in that position, so as to allow circuit-closer R to close the break in the releasing-circuit for S′. The train, on passing circuit-closer *c c′*, then unlocks switch S′, which is then reset to the position shown. As is obvious, said switch cannot be reset until signal A has been set to "danger," and the train has also passed the switch 1, the releasing-circuit of said lever being broken by the switch T at A so long as A is at "safety." The passage of the train over circuit-closer C C′, by closing the circuit of battery M B through the magnet of lock D, also allows switch-bar F to return to its normal position.

It will be observed that when the switch-bar is pulled out it breaks the connection of the battery-strip P O W Z Y; so that even if the switch-bar of that route should be pulled out it could produce no effect upon the circuits controlled by it. In Fig. 6 the method of connecting the other switch and signal operating mechanisms to the route-switch may be traced.

It should be premised that in the normal position of the switch-levers and the signal-levers the switches are set for the route P O W Z Y and the semaphores are at "danger." The locks N being in the position shown, the signals are locked at "danger," and can only be released to be set to "safety" by the completion of a releasing-circuit. The switch-levers are normally unlocked, and the contacts of the electric switches R of said levers therefore closed. The front contacts of the switches T corresponding to said levers are also closed, the back contacts being open. The back contact, *t*, of the switches T for each signal-lever control the local releasing-circuit of the switches D^5 for those route-switch bars which serve to complete the releasing-circuit for any given signal. According to the design of the route-switch as here arranged, the releasing-circuit for the semaphore signal, which must be operated in order to allow the train to pass over any particular route, includes the front contacts of the switches T of those switch-levers which must be retained in their normal position, and the back contacts of the switches for those switch-levers which must be thrown to the right, so as to set the corresponding railroad-switch to the main track. Taking, for instance, the route P O W N, which would require the setting of switch 2 and the retention of switch 3 in normal position, it will be seen, on reference to the manual switch-bar for that route, that the operation of said bar will close the connections to the back contact, *c*, of switch 2, and the front contact, *b*, of switch 3, so that the releasing-circuit of signal C, which is the signal requiring to be set to "safety," can only be completed by allowing switch 3 to remain in the position shown, and by throwing switch 2 so as to close the circuit at the back contact of its electric switch T, the switches R being also allowed to close, which can be only done by locking the switch-levers in the proper position. As in the case of switch-bar X Z Y, the releasing-circuit for the switch-levers of the route in question is completed by the operation of the switch-bar P O W N through the front contact, *s*, of signal C and the releasing electro-magnets of switches 2 and 3, said circuit including a releasing device, D, for the switch-bar and a track-circuit closer, C C^4, which is operated so soon as a train has passed over the railroad-switches on the route P O W N.

Switch-bar P O W N is provided with circuit-breaking studs, as before explained, which break the battery-strips of the conflicting routes P O W Z Y, Y W X, and Y W O P.

Route Y W O P is merely the reverse of P O W N, and only differs therefrom in requiring the setting of signal B to "safety," instead of signal C. On referring to the diagram it will be seen, as in the case of route P O W N, how the back contact of the switch T or switch-lever 3 and the front contact of switch-lever 2 are controlled thereby, and that instead of signal C signal B is included in the releasing-circuit from main battery M B′.

The interlocking of the switches and the signals in the case of every one of the several routes indicated takes place in the manner already described with relation to the route X Z Y. The switch-bar is released by appropriate road-circuit closers arranged to be operated after the train has passed the railroad-switches included in each particular route. This will be readily understood upon reference to the position of the several track-circuit closers C C′, C C^2, C C^3, C C^4, and inspection of Figs. 6, 7, and 8.

It will be noted that route X Z Y conflicts only with route P O W Z Y, and the circuits for the switch 1 and signal A are affected only when the switch-bar of that route is pulled out. The switch-bars of the other routes may be set at the same time with switch-bar X Z Y without any conflict.

The automatic circuit-breaker D^5 for each switch-bar is, as explained, controlled by the back contact, *t*, at the particular signal-lever which is to be operated for that route. Signal B, being included in the switch-bar connections of two routes, operates the releasing-magnet E^4 for the switch-bars for such routes. Signal-lever C in a similar way controls the

releasing electro-magnets E^4 of two other routes. For this purpose but a single local battery may be used.

The manner in which the parts are connected will be readily understood from the diagram Fig. 10, and need not be explained in detail.

In the application of our invention to a junction like that indicated in Fig. 7 one signal only requires to be operated or set to "safety" for each route. In more extended applications some routes may embrace more than one danger-signal, which must be set to "safety" to allow a train to pass. In such cases a separate switch-bar is used for each portion of the route controlled by a signal, the switches on such portion being interlocked with the corresponding signal in the manner already described. Each of such switch-bars will be arranged to control the battery-strips of conflicting routes in the same manner as the switch-bars of Fig. 6, each bar of a compound route of course being arranged so that it can be pulled out simultaneously with the others without interference.

Our invention is not limited to any particular mechanical construction of electric switches, electro-magnets, or locking-levers, and many other forms may be substituted for those shown, provided the circuits and connections be so arranged as to have the mutual dependence described.

Our invention consists in the combination of any electric switch mechanism properly constructed to produce the changes in the electric circuits described with any electro-magnetic locking apparatus applied to the signal and switch operating mechanism in such a way as to be controlled by the switches, and to control the operation of said mechanisms on the principle set forth.

We may use other devices in place of that shown at D^5 for automatically breaking the releasing-circuit when the signal-lever is operated. So, also, other forms of automatic locking and releasing mechanism for the switch-bars and other constructions of bridge-lock-circuit closer may be used, provided they be properly constructed to act mechanically and electrically in the manner set forth, so as to form properly coacting elements in the combinations described.

The switch-levers might be arranged to occupy normally any desired position; but any change in this respect would involve merely a change in the connections to the manual switch. For instance, the railroad-switches might be so constructed or arranged that, with the switch-operating levers in the position shown, said switches would be set to the main track. This, however, would render necessary a rearrangement of the connections from the back and front contacts of T to the manual switch. For instance, if in a position of switch 1 (shown) the switch is set to the main track, switch-bar X Z Y should complete a connection to the front contact of switch T when pulled out, instead of to its back contact, so that said switch could not be thrown and locked without destroying the releasing-circuit for signal A, but must be locked in the normal position.

Other changes will suggest themselves to those skilled in the art, and will readily occur in the practical application of the system to other conditions. The use of normally-closed circuits instead of normally broken, or of normally broken instead of normally closed, in the various parts is one of the evident variations of the particular arrangement described; but as this is a matter within the province of skilled electricians, we do not deem it necessary to describe such modifications in detail.

The electro-magnetically-controlled locking devices may be applied as well to other parts of the mechanism which must be moved or operated in order to set a switch or signal. We have shown it applied to the catch-rod merely for the sake of convenience.

Instead of locking devices, other electro-magnetically-controlled mechanisms might be used for rendering the railroad signal or switch mechanisms operative or inoperative, according to the requirements of the case.

The switches T might be changed very greatly in form, and might be applied to other parts of the railroad switch or signal, so as to make the proper connections in the various positions of the switch or signal.

What we claim as our invention is—

1. The combination, with the operating mechanisms for electric railway signals, switches, or draw-bridges, of locking devices provided with releasing electro-magnets, releasing electric circuits for said electro-magnets, and two or more manual electric switches, each of which is adapted to complete a releasing-circuit for the unlocking device of the mechanism or mechanisms which it is desired to operate, and is provided with circuit-breaking devices for rupturing the releasing circuit or circuits for the mechanism or mechanisms which should at the same time be rendered incapable of operation.

2. An interlocking apparatus for railway semaphore and switch or draw-bridge operating mechanisms, comprising, in combination, electro-magnetically-controlled locks for said mechanisms, manual electric switches, controlling releasing-circuits, and circuit-breaking devices connected with each manual switch for breaking the releasing circuit or circuits for the mechanism or mechanisms which should at the same time be rendered inoperative.

3. The combination, substantially as described, with the railroad switches and semaphores at a railroad junction, of electro-magnetically-controlled locking devices for the mechanisms by which the conflicting switches and signals are operated, and an electric manual route-switch controlling electrically-interdependent circuits for said locking devices, as and for the purpose described.

4. The combination, with the operating mech-

anisms for the signals at a railroad junction, of locking devices, releasing electro-magnets controlling such locking devices, and a series of manual electric switches, each controlling the releasing-circuits for two or more conflicting signals.

5. The combination, with the operating-levers of a railroad switch or semaphore, of mechanism for locking said levers, electro-magnets for releasing said mechanisms, each in a separate electric circuit, and a manual switch, arranged in the manner described, to connect said releasing electro-magnets with the circuit-connections from operating-batteries.

6. The combination, with the operating mechanisms for a railroad switch and semaphore, of electro-magnetically-controlled locking devices, independent electric circuits, one of which includes the releasing electro-magnet of the switch and a circuit-controller operated by the electro-magnet of the signal, the other the releasing electro-magnet of the signal and the circuit-controller operated by the electro-magnet for the switch, and a manual electric switch adapted to connect each circuit to a galvanic battery.

7. The combination, with a railroad switch and signal, of a releasing electro-magnet for each, and circuit-connections for the switch electro-magnet through a circuit-controller operated by the signal electro-magnet, a railroad-circuit closer for completing said circuit, circuit-connections from the signal electro-magnet through a circuit-controller operated by the switch electro-magnet, and the manual electric switch arranged to place said connections in the circuit of a galvanic battery.

8. The combination, with the operating mechanism for a railroad signal or draw-bridge lock, of the electro-magnetically-controlled locking devices for said mechanism, a manual electric switch controlling the circuit for said locking devices, and an electro-magnetic locking device for the manual electric switch, controlled or released by means of a bridge-lock-circuit closer, or a circuit-closer operated by the passage of a train.

9. The combination, with the operating mechanism for a railroad signal or draw-bridge lock, of electro-magnetically-controlled locking devices for said mechanism, a manual electric switch controlling the circuit for said locking devices, and an electro-magnetic releasing device for the manual electric switch, the electro-magnet of which is in circuit with the releasing electro-magnet for the railroad switch or bridge-lock, and with a track or bridge-lock circuit closer.

10. The combination, with the operating-levers for a series of railroad switches and railroad-signals, of electric switches arranged to be operated by the railroad-switch levers, and provided with back and front contacts, the former of which is closed when the switch-lever is thrown from its normal position and the latter when said switch-lever remains at normal, and a series of electric switches for controlling the switch-levers and signal-levers of the various routes, each of said switches being provided with suitable circuit-connections, as described, whereby it may be made to place the releasing electro-magnet for a signal in circuit with the back contacts of the electric switches for those railroad-switches which require to be thrown from normal and in circuit with the front contacts of those which require to be set at normal in order to allow a train to pass over the desired route.

11. The combination, with the two operating-levers for an electric railway-signal and for a railway switch or draw-bridge, of locking devices released by electro-magnets, and electric switches arranged to be thrown by said levers, when the lever is moved, for the purpose of throwing the railroad switch or signal to or from its normal position, the switch for each of said levers being arranged to make or break the controlling electric circuit for the releasing electro-magnet of the other lever.

12. The combination, with the operating mechanisms of a series of railroad switches and signals, of releasing electro-magnets for the same, separate controlling-circuits for the magnet or magnets of the switches and for the magnet of a signal, electric switches arranged to be opened or closed, according as the railroad switch or signal is locked or unlocked, and electric switches adapted to be operated when a signal or railroad-switch operating mechanism is thrown to or from its normal position, the electric switches combined with the signal being arranged in the releasing-circuits for the electro-magnets of the railroad-switches, while, vice versa, the electric switches combined with the railroad-switch mechanisms are arranged in the releasing-circuit for the signal.

13. The combination, with a series of railroad-signals and switch-operating mechanisms, of electric magnetic locking devices, manual electric switches, one for each desired combination of switches and corresponding signal, and circuit closers and breakers for each manual switch, arranged, in the manner described, to close the connections to releasing electro-magnets for the switches, and the proper signal for any desired combination of switches, and to break the battery-connections for the signal of conflicting combinations.

14. The combination, with the operating mechanisms for a series of railroad switches and semaphores at a railroad junction, and with locking devices for the same, of releasing electro-magnets and a manual electric switch having circuit-connections for placing the releasing electro-magnet for a semaphore in circuit with a battery through electric switches operated by the railroad-switches and their locking mechanisms, and for simultaneously connecting the releasing electro-magnets for the railroad-switches to a battery and track-circuit closer, all being arranged in the manner set forth, so that when the electric switch

is set the signals cannot be operated to allow the train to pass until the railroad-switches have been set and locked in the proper position, and the latter cannot be unlocked until the train, by passing the track-circuit closer, energizes their releasing-magnets.

15. The combination, with the operating mechanism for a switch or draw-bridge lock and for a semaphore or signal indicating the condition of such switch or draw-bridge, of unlocking devices, actuating electro-magnets for the same, and circuit-breakers actuated by said electro-magnets, each of said circuit-breakers being arranged in the releasing-circuit or the electro-magnet which operates the other, so that when either electro-magnet is energized for the purpose of unlocking one of said mechanisms the releasing electric circuit of the other electro-magnet will be broken.

16. The combination, substantially as described, with the operating mechanism for a railroad-switch, railroad-signal, or draw-bridge lock, of a locking device and a detaining-armature, which serves in one position to detain said locking device in locking position, and which in the other position of said locking device is itself detained by said locking device, a circuit closer and breaker connected with the armature, and a locking-rod, *p*, or equivalent device, for throwing the lock into locking position and simultaneously releasing the armature.

17. The combination, with the operating mechanism for a railroad-switch, draw-bridge lock, or signal, of a locking-lever provided with a retractor which normally tends to throw it out of locking position, mechanism for throwing said lever into locking position, an armature arranged, when retracted, to detain said lock, and when attracted to release said lock and be in turn detained by it, and a circuit-closer operated by the armature, and acting in one position of the same to open and in the other to close an electric circuit for the detaining electro-magnet and armature of another lock.

18. The combination, with the locking-lever N and its retractor, of the armature-lever and its retractor, arranged to hold the armature in the path of the lever N, circuit-closer R, and operating-rod *p*.

19. The combination, with the operating-lever L for a railroad switch or signal, of a reciprocating spring-actuated circuit-closer arranged in the path of said lever, so as to be actuated thereby when said lever is in one of its extreme positions, and provided with a circuit-closing spring or point, which closes or breaks an electric circuit for the controlling electro-magnet of another switch or signal operating mechanism, according as the circuit-closer is engaged by the lever or is under the influence of its spring.

20. The combination, with the operating mechanism for a railroad-switch, of a reciprocating spring-actuated circuit-closer arranged in the path of said operating mechanism, so as to be actuated thereby at one of its extreme positions, and two circuit-closing points or springs arranged to close each an electric circuit, according as the circuit-closer is in one or the other of its extreme positions, one of the circuits thus closed containing the locking devices for the signal which should be set with the switch and the other the devices for the signal or signals which should remain locked.

21. The combination, with the actuating-lever L, of the reciprocating rod T, its actuating-spring, and the spring-contact *s*.

22. The combination, with the actuating-lever L, of the reciprocating rod T and its operating-spring and spring-contacts *s t*.

23. The combination, with the operating mechanism for a railroad switch or signal, of an electric switch operated by the lock-releasing electro-magnet, and a second circuit-closer, T, arranged in the path of the operating mechanism, and placed in circuit with the first-named circuit-closer, all in the manner described, so that said circuit is made to depend upon both the position of the operating mechanism and the condition of the lock for said mechanism.

24. The combination, with the reciprocating switch-rod F, of conducting and non-conducting studs and contact-springs *g g*, arranged in the path of said studs, and forming parts of electric circuits, as and for the purpose described.

25. The combination, with a series of reciprocating switch-rods provided with conducting and non-conducting studs, of independent separable conducting-strips transversed to said rods, and arranged in the manner described and shown, so that the non-conducting pins upon one rod may break a strip or strips through which another rod or rods obtains electrical connection.

26. The combination, with the reciprocating switch-rod F, controlling the electro-magnetic locking and unlocking devices of a railroad switch or signal, of an automatic mechanical locking device and a releasing electro-magnet connected to a railroad or bridge-lock circuit closer.

27. The combination, with the switch-bar F, of a locking-lever, a detaining-armature, and releasing electro-magnet connected to bridge-lock or a railroad-circuit closer.

28. The combination, with the switch-bar F, controlling the circuit for signal-releasing devices, of a circuit-closer in said releasing-circuit controlled by the switch-bar, a locking electro-magnet for said circuit-closer, and a circuit-closer operated by the signal mechanism for closing the circuit of said electro-magnet, so as to break the releasing-circuit at the point where it is completed by the first-named circuit-closer.

29. The combination, with the signal-lever L and its unlocking electro-magnet, of a switch controlled by said electro-magnet and placed

in the circuit with the releasing-magnet for a railroad-switch mechanism, a circuit-closer in the releasing circuit for the signal mechanism, and a releasing electro-magnet for said circuit-closer, the circuit of which is closed when the signal-lever is thrown.

30. The combination, with the circuit-closer 21, of the switch-bar F, automatic locking devices for said circuit, and a releasing electro-magnet connected to a circuit-closer operated by the signal-lever.

31. The combination, with the switch-bar for completing the releasing-circuit closer for the bridge-lock lever, of an automatic locking device and an electro-magnet for releasing the same, controlled by a bridge-lock-circuit closer adapted to close the circuit only when said lock is moved to lock the bridge.

Signed at New York, in the county of New York and State of New York, this 21st day of July, A. D. 1882.

JNO. K. KNIGHT.
WM. H. BAKER.

Witnesses:
THOS. TOOMEY,
GEO. C. COFFIN.