No. 637,678. Patented Nov. 21, 1899.

W. R. SYKES.

EXPLOSIVE SIGNALING APPARATUS FOR RAILWAYS.

(Application filed Sept. 13, 1899.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1.

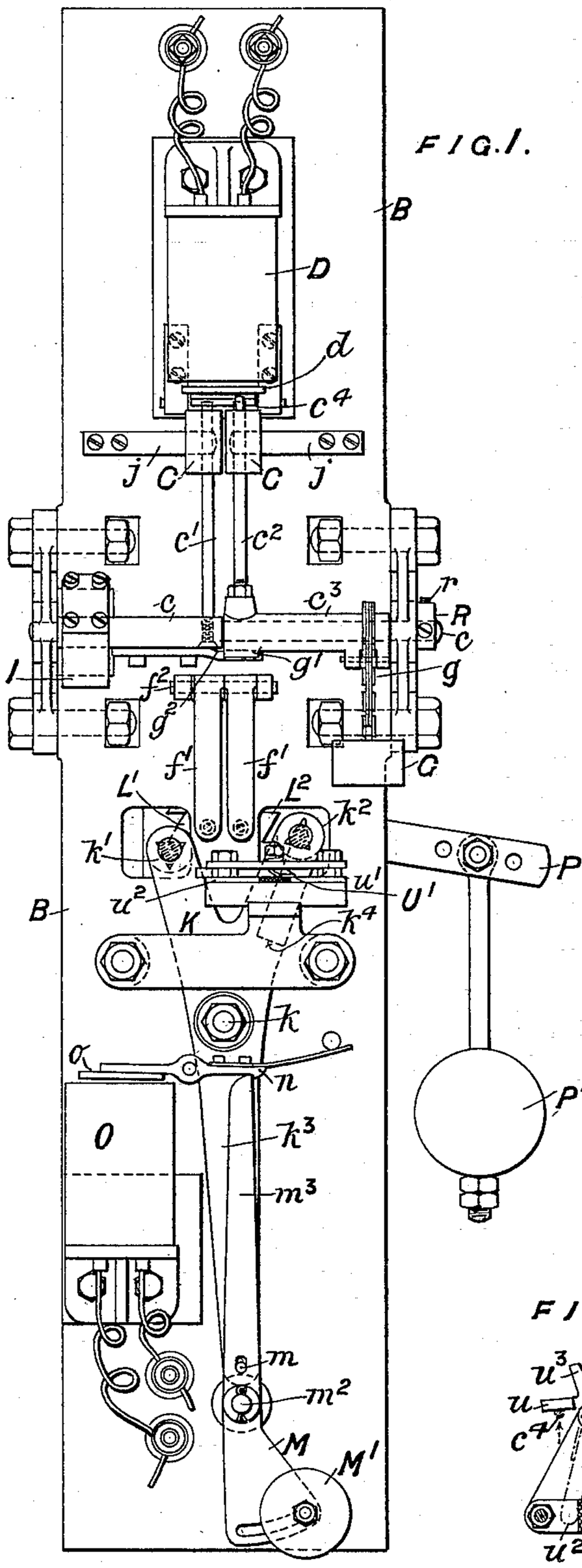
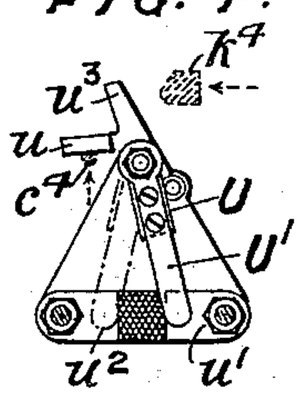


FIG. 4.



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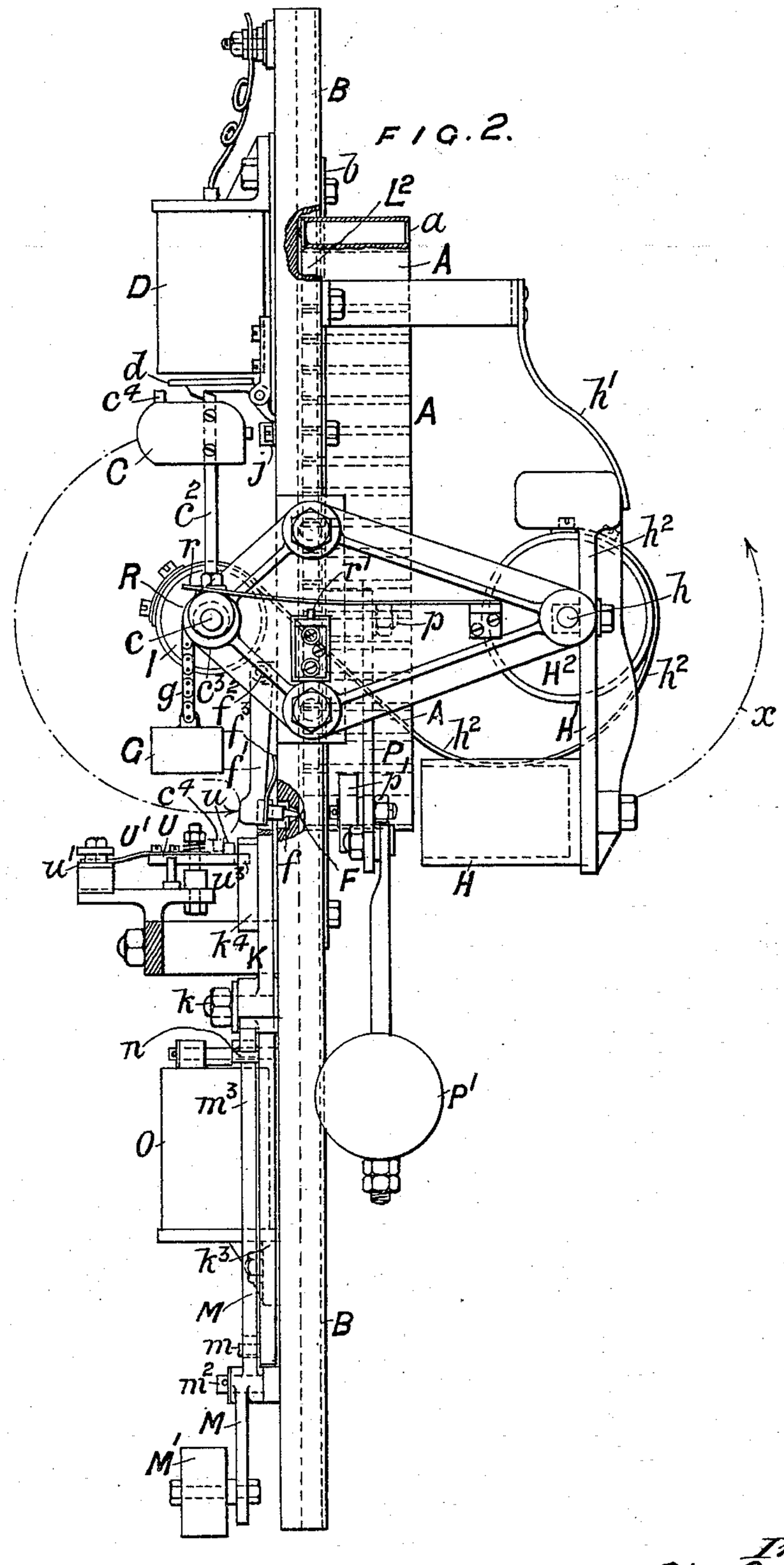
(No Model.) 4 Sheets—Sheet 2.

FIG. 2.



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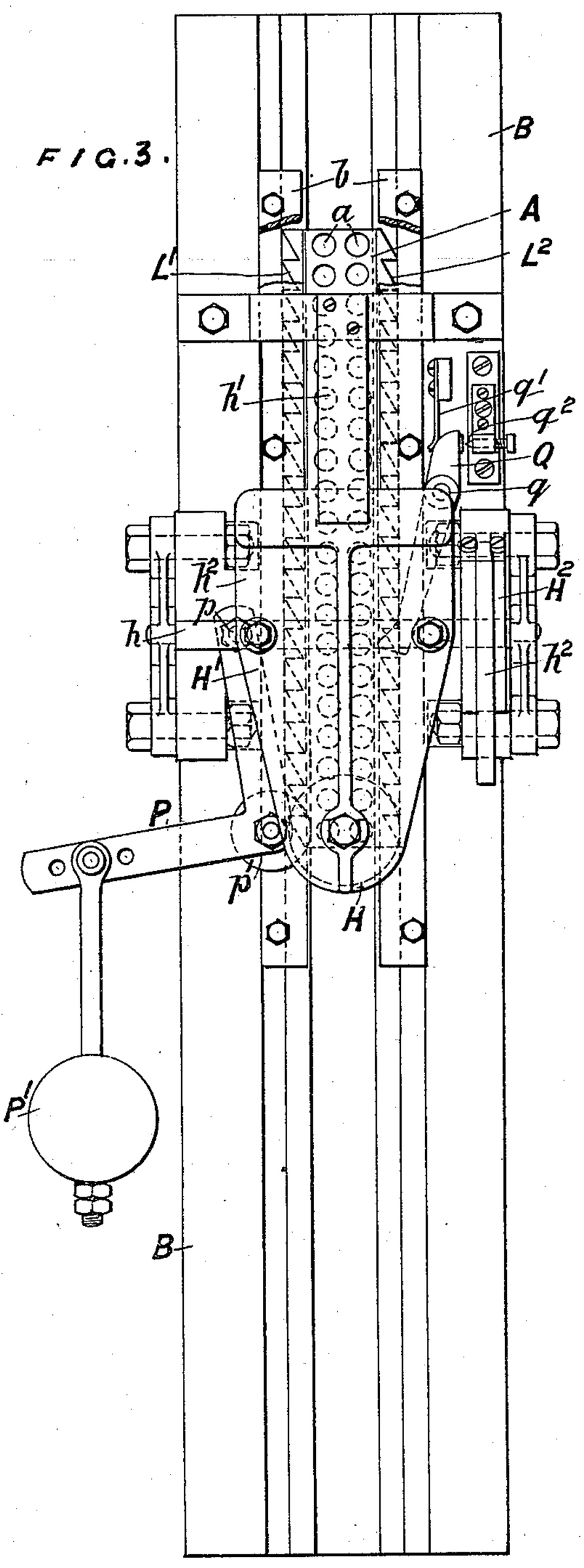
(No Model.) 4 Sheets—Sheet 3.

FIG. 3.



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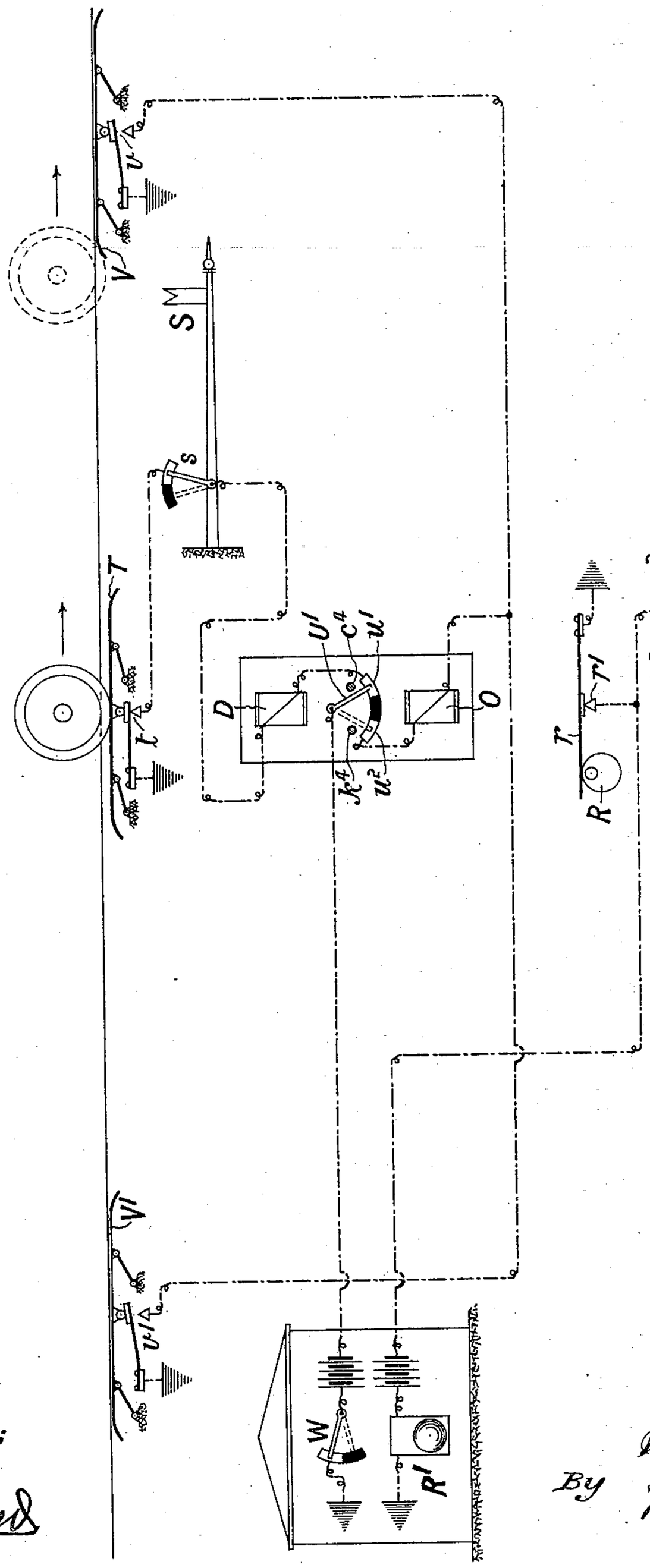
(No Model.) 4 Sheets—Sheet 4.

FIG. 5



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UNITED STATES PATENT OFFICE.

WILLIAM ROBERT SYKES, OF LONDON, ENGLAND.

EXPLOSIVE SIGNALING APPARATUS FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 637,678, dated November 21, 1899.

Application filed September 13, 1899. Serial No. 730,332. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ROBERT SYKES, railway signal and telegraph engineer, a resident of Station road, High street, Clapham, London, S. W., England, have invented new and useful Improvements in Explosive Signaling Apparatus for Railways, (for which an application for patent has been filed in Great Britain, dated November 7, 1898, No. 23,410,) of which the following is a full, clear, and exact description.

This invention relates to electric train-operated explosive signaling apparatus for railways, and has for its object to provide an apparatus of simple and inexpensive construction whose operation may be made automatically dependent on the position of the ordinary visual signals.

The apparatus comprises a gravity-operated cartridge holder or magazine having a series of pairs of cartridge-chambers adapted to be brought by the step-by-step motion of a rack under the control of an escapement successively a pair at a time into firing position, a pair of gravity-operated firing-hammers normally held in the raised or operative position, so as when released to fall and explode the pair of cartridges for the time being in firing position, means whereby the hammers are automatically reset by the force of the explosion itself, consisting of a discharge-receiving device adapted to receive and apply the force of the explosion to raise the hammers, the discharge-receiver being pivoted and counterweighted and coupled with the hammers by a strap reversely wound on barrels on the axis of the one and of the other, means of electrically controlling the fall of the hammers, so as to render the discharge dependent on the position of the visual signal, electrical means of giving warning of failure to act, and means of rendering the discharge and the operation of the cartridge-chamber for bringing fresh cartridges into firing position dependent on the passage of a train and for adapting the apparatus for use on single lines or in situations where trains pass in both directions on the same rails.

Reference is to be had to the accompanying drawings, forming part of this specification, wherein—

Figure 1 is a front view of the explosive signaling apparatus, Fig. 2 being a side view, partly in section, and Fig. 3 a back view, of the same. Fig. 4 is a plan view of one of the switches, and Fig. 5 is a diagram of the electrical connections between the apparatus and the corresponding semaphore-signal and the signal-cabin.

The cartridge holder or magazine consists of a vertical bar A, having a series of pairs of horizontal chambers *a a*, each adapted to contain an explosive cartridge, the holder being capable of downward movement under the influence of gravity in vertical guides *b* in a frame B under the control of rack-and-escapement mechanism hereinafter described, whereby the cartridges are brought successively a pair at a time into position to be exploded by the firing-hammers. The latter consist of a pair of levers c' c^2, pivoted about a common horizontal axis *c* and each having a weighted head C, normally held raised by a latch *d*, attached to the armature of an electromagnet D, by whose action when excited by a current the latch *d* is released for the purpose of allowing the hammers simultaneously to descend by an angular movement about the axis *c* and explode the cartridges.

The pair of cartridges to be exploded when in the firing position are presented each with its percussion-cap centrally opposite to a hole *f* in the frame B, and the discharge of each cartridge is effected by a pin F, which is mounted on an arm f', hung from a center f^2, and is driven through hole *f* into the percussion-cap at the rear of the cartridge when the back of the lever is struck by the corresponding hammer-head C in its descent. The arm f' is pressed upon by a spring f^3, so as to normally hold the firing-pin F just clear of the cartridge, but within the bell-mouthed aperture of the hole *f*, to which position the arm and pin are caused to return on the recoil of the hammer by the spring f^3.

Each member of the pair of hammers is independently hung, the one on the shaft *c* and the other on a sleeve c^3, loose on said shaft. The fall of both hammers is accelerated by the descent of a weight G, suspended by the chain *g*, which is wound around the sleeve c^3, so as to actuate directly the hammer mounted on said sleeve, the weight acting upon the

other hammer by the engagement of a lug g' on the sleeve with a lug g^2 on the shaft c.

The means whereby the force of the explosion is utilized for the purpose of automatically resetting the hammers in firing position comprises a cylindrical or cup-shaped bell H, hung by one arm of a lever H′ from a shaft h in position to receive the discharge from the pair of cartridges, the force of the explosion causing the lever H′ to turn about its fulcrum h in the direction of the arrow x in Fig. 2 until checked by the buffer-spring h', which insures the return of the lever and bell to the "set" position and also (by engaging with the counterweighted arm of lever H′) serves as a stop for the same when so returned. On shaft h is keyed a pulley H^2, to whose periphery is fixed a belt h^2, which is also attached to the periphery of a pulley I, fast on the shaft c, the belt being arranged as shown in Fig. 2, so that on the bell H being thrown upward by the explosion in the direction of the arrow the belt causes the rotation of shaft c in the direction to cause the hammers to recoil to the set position, where they are retained, as before, by latch d, the hammer mounted on shaft c being actuated directly and the one mounted on sleeve c^3 being acted upon by the engagement of lug g^2 with lug g'. It is to be noted that when the hammers C and bell H are in the set position, as shown in Fig. 2, the belt h^2 is just slack enough to allow the hammers to fall freely, the slack being taken up by the rotation of pulley I, due to the fall of the hammers, so that the rotation of pulley H^2, consequent on the explosion of the cartridges, at once causes a pull to be exerted through the belt for the purpose of resetting the hammers, the force of whose recoil is received by a pair of springs $j\,j$, which cause the hammers to rebound until stopped and retained by the latch d. In order to insure such engagement of the latch with the hammers at the proper moment, the latch-lever is provided with a downwardly-projecting arm d', adapted to be engaged by the back of the hammer-heads C when these reach the limit of their recoil, so that the latch, which had been raised by the hammers as they passed to their extreme position, is thus caused to descend into position to engage the hammers on their rebound.

The escapement mechanism controlling the descent of the magazine A comprises a Y-shaped anchor-escapement lever K, fulcrumed at k on the frame B of the machine and carrying on one of its upwardly-directed Y-arms a pallet k', adapted, when lever K occupies its normal position, to engage the downwardly-directed teeth of a rack L′, (whose pitch is equal to that of successive pairs of cartridge-chambers in the magazine,) fixed to one side of the magazine A, whose descent is thus prevented. The other Y-arm of lever K carries a pallet k^2, adapted to be acted upon in their descent by the upwardly-directed teeth of a rack L^2, (of same pitch as rack L′,) fixed to the corresponding side of the magazine A. The tail end k^3 of lever K has a pin-and-slot connection at m with the upper arm m^3 of a balance-lever M, fulcrumed at m^2, whose lower arm carries an adjustable weight M′, whereby the lever is caused (when free to vibrate) to so act upon lever K that the pallet k' (which normally engages with a tooth of rack L′) is released and permits the magazine A to descend. The lever M is normally prevented from so acting by the engagement of its upper arm m^3 with a spring-pressed latch n, forming one arm of the armature-lever of an electromagnet O, which when excited attracts its armature o, thus releasing latch n from lever M, whose arm m^3 is vibrated by weight M′ toward the right in Fig. 1. The tail end k^3 of lever K is consequently vibrated also toward the right, whereby pallet k' is retracted from engagement with rack L′. The magazine A therefore descends, and in so doing the inclined back of the next following tooth of rack L^2 presses upon pallet k^2 and vibrates lever K, causing the latter to return to its normal position, so that pallet k' engages with the next tooth of rack L′ following that from which it has just been retracted. In its return movement lever K acts, through the pin-and-slot connection m, on lever M, so as to return the latter to its normal position of engagement with latch n, whereby further descent of the magazine is prevented.

It being necessary that the magazine A should descend easily in its guides b, the latter are made a slack fit, and in order that the exact registration of the percussion-cap (at the rear of each cartridge) with the pin-hole f in the frame B should not thereby be liable to be disturbed the elbow-lever P, carrying the weight P′ and fulcrumed to the frame at p, is caused to exert a constant pressure by means of the roller p' against one side of the cartridge-holder, so steadying the latter.

A lever Q, pivoted at q to the frame B, is pressed by spring q' against one side of the cartridge-holder A, so that when the top of the latter in its descent passes the tail of the lever (which is arranged to happen when the majority of the cartridges have been exploded) the upper end of the lever closes, through a contact q^2, an electric circuit, whereby a bell R′ is rung in the signal-cabin (see Fig. 5) to warn the signalman that the cartridge holder or magazine A requires replenishing. In order to save time, this is preferably done not by then refilling the same magazine, but by inserting a fresh one in the guides b from above, the new magazine descending, as before, by gravity into operative position. The distance between the last pair of cartridge-chambers of the old or exhausted magazine and the first pair of chambers of the new or full magazine is equal to that between adjacent pairs of cartridge-chambers in both magazines and to the pitch of the racks L′ and L^2, so that the working of the apparatus

is not interrupted by the passage from the old to the new magazine, the former of which drops out at bottom of the guides and may be removed and refilled at leisure.

Upon the hammer-shaft *c* is keyed a cam R, by which when the hammers fall the electric-circuit-closing spring *r* is permitted to touch the contact *r'*, thus establishing a circuit by means of which the bell just referred to is rung in the signal-cabin to apprise the signalman of the fall of the hammers. If the cartridges are exploded by this fall of the hammers, the bell-signal thus transmitted is of only momentary duration, owing to the immediate recoil of the hammers, causing cam R to at once raise spring *r* off contact *r'*; but if no explosion takes place, the bell H not being thrown up, the hammers remain also down in firing position and the bell in the cabin continues ringing until the apparatus has been attended to and reset.

The means whereby the various portions of the apparatus are electrically controlled and their movements coördinated are as follows: The electromagnet D, which when excited permits the fall of the firing-hammers, is in circuit, on the one hand, with a switch *s*, Fig. 5, operated by or concurrently with the raising of the visual signal or semaphore S to "danger," so as to be dependent thereon, and, on the other hand, with a circuit-closer *t*, operated through a treadle T, placed in the immediate vicinity of the apparatus, when said treadle is depressed by the leading wheel of a passing train. The circuit is thus so far completed by the act of raising the semaphore-signal to "danger;" but the cartridges are not fired until by the passage of a train the circuit of magnet D, controlling the fall of the hammers, is closed.

A pin c^4 on one of the firing-hammers C engages in its fall with the arm *u* of a three-armed lever U, Fig. 4, by means whereof a switch is operated, whereby the action of the escapement K is controlled and coördinated with that of the hammers, so as to effect the bringing into position of a fresh pair of cartridges at the proper time. A second arm of lever U carries a brush U', which normally rests upon a contact *u'*, through which and through the brush the circuit of magnet D is normally so far completed. When, however, by the fall of the hammers C the lever U is actuated, the brush U' passes on to another contact u^2 in the circuit of the escapement-controlling magnet O, this latter circuit being completed and the escapement permitted to act when by the passage of the leading wheel of the train over a second treadle V, placed at a distance of somewhat more than a train length—say three hundred yards—in advance of the treadle T, the circuit-closer *v* in the circuit of magnet O is operated. The consequent vibration of the escapement-lever K returns the brush U' to initial position, a third arm u^3 of lever U engaging for this purpose with a block k^4, fixed to lever K.

A switch W may be placed in the signal-cabin, as indicated in Fig. 5, so as to enable the circuits controlling the operation of the apparatus to be completed or broken, in accordance with the state of the weather or other governing conditions, without the necessity of the signalman leaving his cabin.

In order to adapt the apparatus for being worked by trains running in either direction, the treadle-operated circuit-closing mechanism V *v* for the circuit of the escapement-magnet O would merely be duplicated, as at V' *v'*, Fig. 5, in advance and in rear of the treadle-operated circuit-closing mechanism T *t*, by which the firing-hammers are released, the second circuit-closer *v'* being connected by a branch wire to magnet O. It will be obvious that as the train must pass over and depress the treadle T before the closure of either *v* or *v'* can cause a current to pass through the coil of magnet O it follows that the depression of whichever of the treadles V or V' is first encountered by the train will be inoperative as regards the escapement mechanism, the circuits controlled by both V and V' being broken at contact u^2 until after the hammers, released by the depression of treadle T, have fallen, as previously described.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is—

1. An explosive signaling apparatus for railways, consisting of a gravity-operated cartridge holder or magazine, an escapement adapted to permit of the movement of the magazine for bringing the cartridges successively into firing position, a gravity-operated firing-hammer which is normally held in the raised position and is adapted to be automatically reset by the force of the explosion, means for releasing the hammer on the passage of a train, consisting of an electromagnet, a circuit-closer, and a treadle mechanism actuated by the train, means of rendering the operation of the escapement dependent on the passage of a train, consisting of a gravity-operated lever adapted to release the escapement, a latch which normally prevents such action of the lever, an electromagnet adapted to withdraw the latch from engagement with the lever, and a second treadle-operated circuit-closer, and a switch so constructed as to be acted on by the hammer and by the escapement to alternately switch the one electromagnet out of, and the other electromagnet into, circuit, the whole combined and arranged for operation, substantially as specified.

2. In an explosive signaling apparatus for railways, the combination with a gravity-operated magazine having a series of separate chambers to contain cartridges and provided with racks, one having upwardly-directed teeth and the other with downwardly-directed teeth, and a hammer for exploding said car-

tridges controlled by the train, of electrically-controlled train-operated escapement mechanism adapted to permit of the cartridges being brought successively into position to be exploded, such mechanism consisting of an anchor-escapement one of whose pallets normally engages the downward-directed teeth of a rack on the magazine so as to sustain the latter, while the other pallet is adapted to be engaged by the upwardly-directed teeth of a second rack when the first is withdrawn so as to effect the return of the escapement to its normal position, a gravity-operated lever coupled to the anchor-lever so as to tend to release the escapement, a latch which normally prevents such action, an electromagnet whose armature when actuated withdraws the latch from engagement with said lever, and a treadle-operated circuit-closer actuated by the train, substantially as specified.

3. In an explosive signaling apparatus for railways, the combination with a gravity-operated cartridge-magazine, and means for bringing the magazine into position to permit the cartridges to be successively fired, of a pivotally-mounted gravity-operated firing-hammer normally held in the "set" or operative position, means for releasing the hammer to allow it to fall and explode the cartridge, and means for automatically resetting the hammer, consisting of a lever rotatable about its fulcrum by the impact of the charge when exploded, pulleys on the axes of the lever and hammer respectively, and a band attached to the pulleys for transmitting the motion of the lever to the hammer, substantially as specified.

4. In an explosive signaling apparatus for railways, the combination with a gravity-operated cartridge-magazine, and means for bringing the magazine into position to permit the cartridges to be successively fired, of a pivotally-mounted gravity-operated firing-hammer normally held in the "set" or operative position, means for releasing the hammer to allow it to fall and explode the cartridge, and means for rendering such action of the hammer dependent on the passage of a train, said means consisting of a treadle-operated circuit-closer in proximity to the rails and in circuit with an electromagnet adapted, when excited, to release the hammer, substantially as specified.

5. In an explosive signaling apparatus for railways, the combination with a cartridge-magazine, a firing-hammer, and an escapement mechanism for the magazine, whereby cartridges are permitted to be successively brought, by step-by-step movement into position to be exploded by the firing-hammer, of means whereby the action of said escapement is rendered dependent upon the passage of a train, said means consisting of an electromagnet, a treadle-operated circuit-closer in proximity to the rails and in circuit with the electromagnet, a gravity-operated lever, and a latch in engagement with the said lever and operated by the electromagnet, whereby the escapement is withdrawn from engagement with the magazine, substantially as specified.

6. An explosive signaling apparatus for railways, comprising a gravity-operated cartridge holder or magazine, an escapement adapted to permit of the cartridges being brought successively into firing position, means of rendering the release of the escapement dependent on the passage of a train, consisting of an electromagnet, a latch which normally retains the escapement in engagement with the magazine but is retracted by the electromagnet, and a treadle-operated circuit-closer, a pivotally-supported and gravity-operated firing-hammer normally held in position to act when released, on the passage of a train, by the action of an electromagnet in circuit with the said treadle-operated circuit-closer, electrically-controlled releasing mechanisms for the escapement and the firing-hammer respectively, and means for electrically coördinating the action of said mechanisms, consisting of a switch adapted to be actuated in the one direction by the hammer in its fall so as to switch a current to the electromagnet controlling the operation of the escapement, and to be actuated by the escapement in the other direction so as to switch the current to the electromagnet controlling the operation of the firing-hammer, substantially as specified.

7. In an explosive signaling apparatus for railways, the combination with a gravity-operated cartridge holder or magazine, and a hammer for exploding the cartridges, both the magazine and hammer being controlled by the train, of a weighted lever adapted to bear against one side of the magazine so as to hold the same steady in its guides while permitting freedom of downward movement, substantially as and for the purpose specified.

8. In an explosive signaling apparatus for railways, the combination with a gravity-operated magazine, and means for bringing the magazine into position to permit the cartridges to be successively exploded, of a pivotally-mounted gravity-operated firing-hammer, means as described, whereby the force of the explosion is utilized for resetting the hammer to the operative or "set" position, and means whereby an audible signal is given in the signal-cabin, consisting of a switch in circuit with an electric bell, and a cam for operating the switch, said cam being fixed on the axis about which the hammer rotates in its fall, substantially as and for the purpose specified.

Signed by me, the said WILLIAM ROBERT SYKES, this 31st day of August, 1899.

WILLIAM ROBERT SYKES.

Witnesses:

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T. W. KENNARD.