(No Model.) 8 Sheets—Sheet 1.

F. STITZEL & C. WEINEDEL.

ELECTRIC SEMAPHORE.

No. 445,653. Patented Feb. 3, 1891.

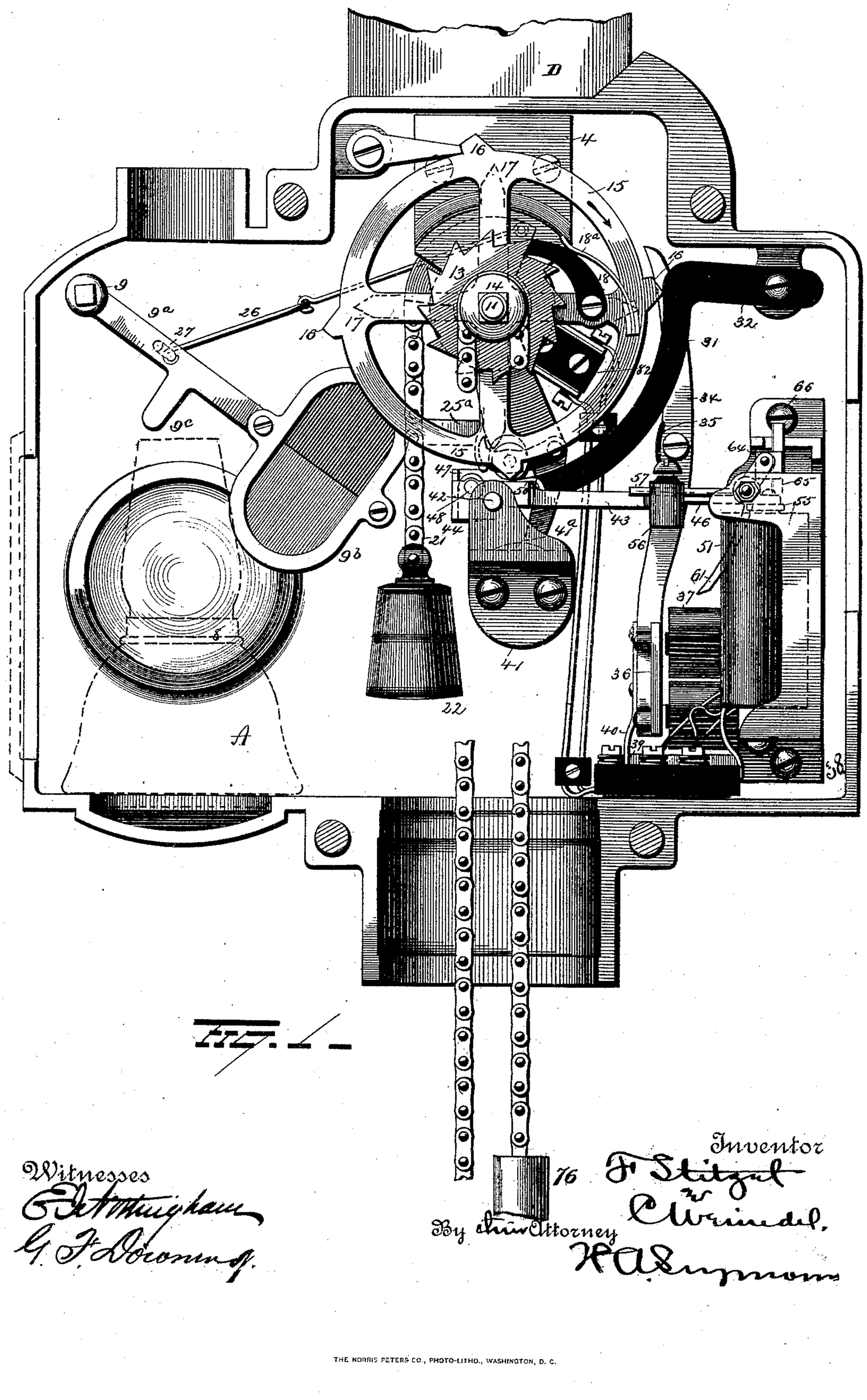

Fig. 1.

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(No Model.) 8 Sheets—Sheet 2.

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ELECTRIC SEMAPHORE.

No. 445,653. Patented Feb. 3, 1891.

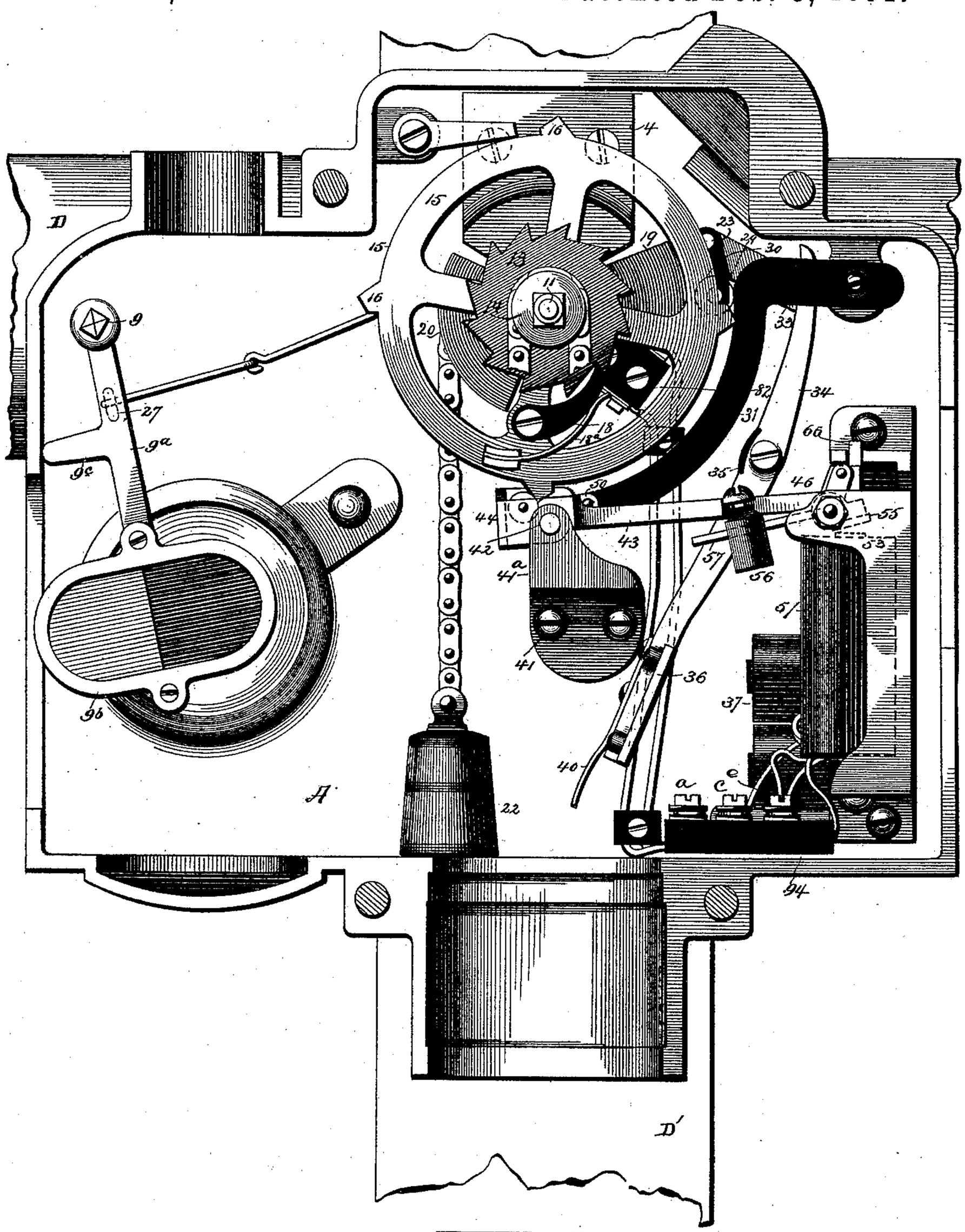

Fig. 2.

Witnesses
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ELECTRIC SEMAPHORE.

No. 445,653. Patented Feb. 3, 1891.

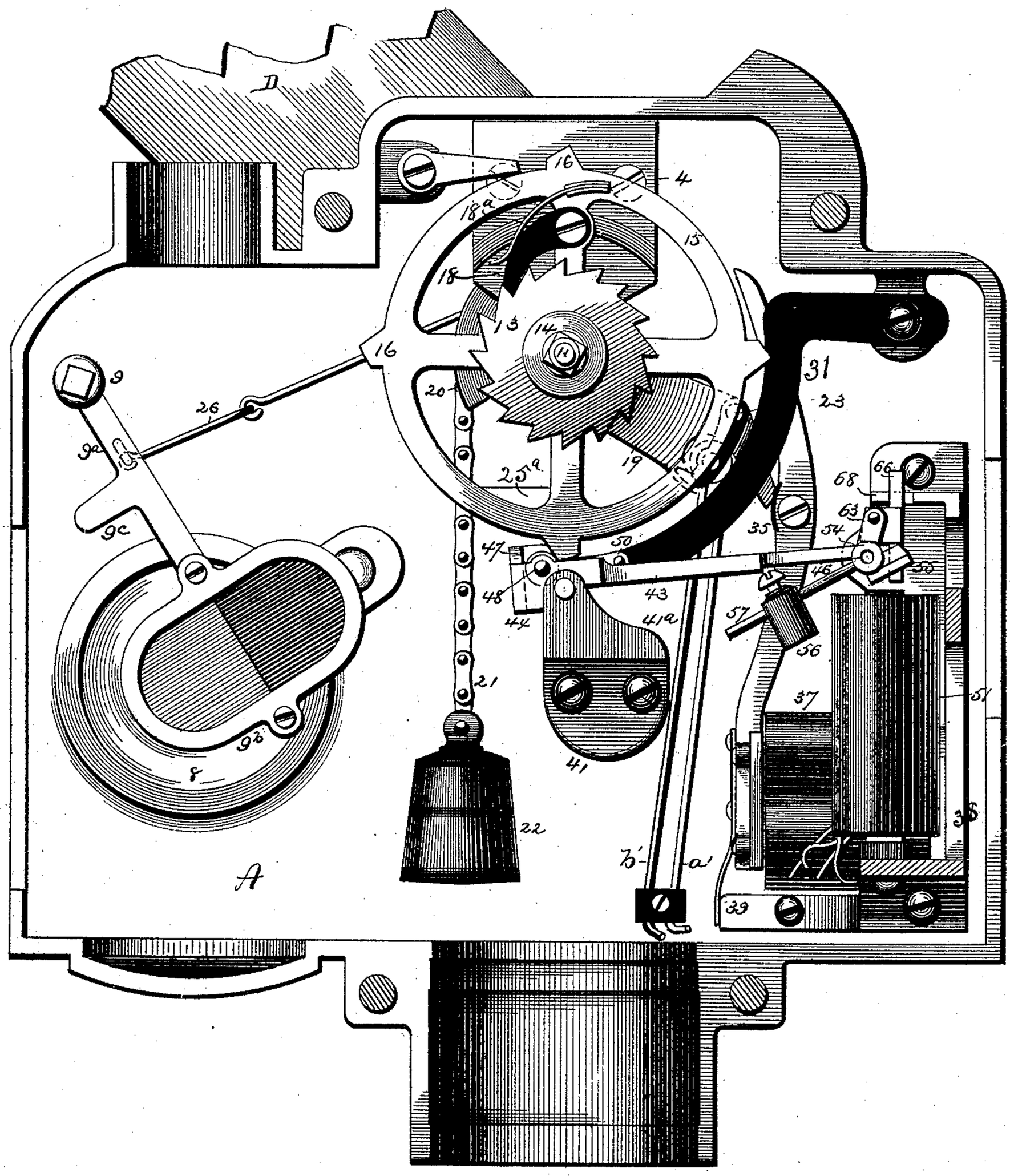

FIG. 3.

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(No Model.) 8 Sheets—Sheet 4.

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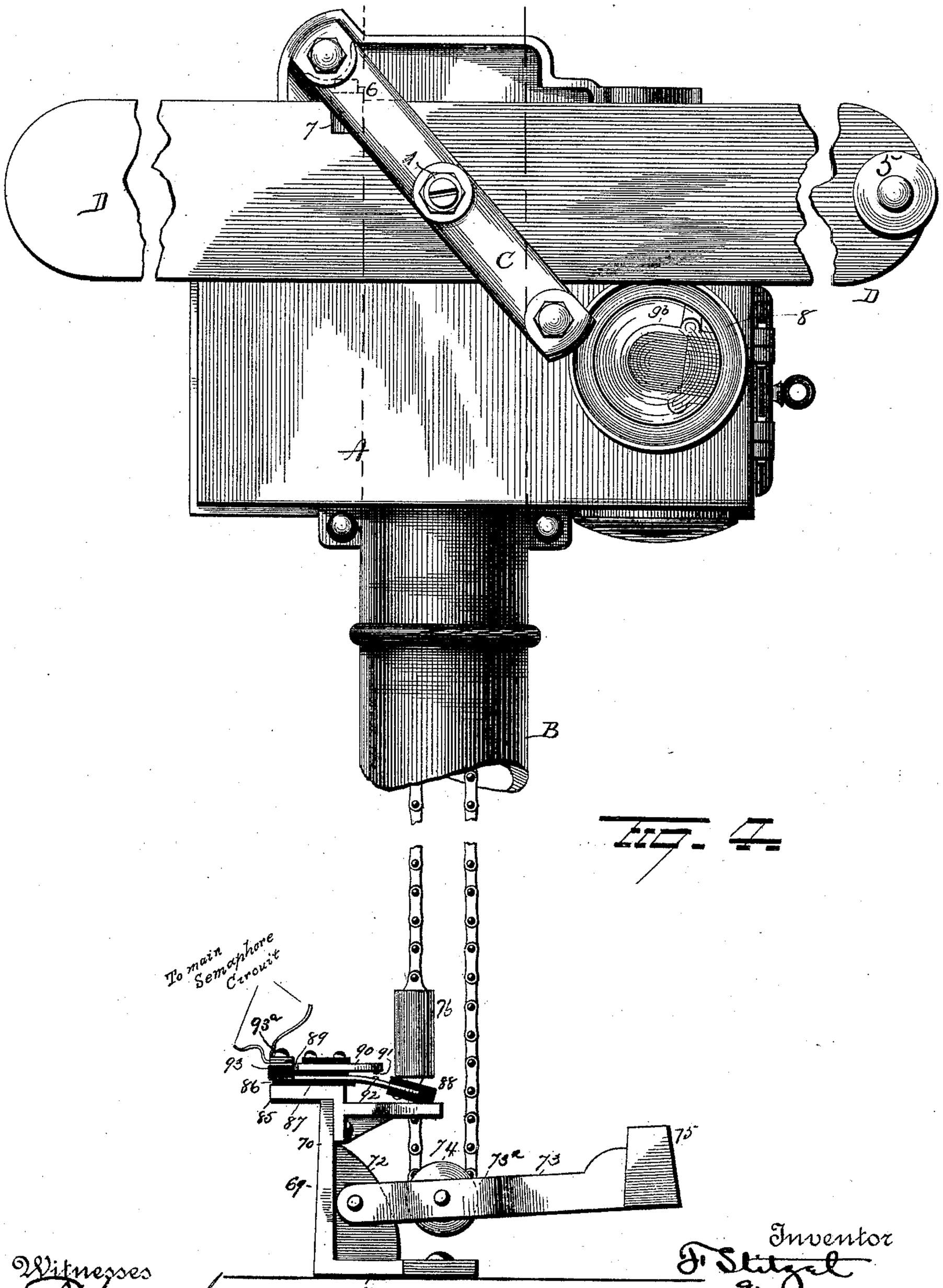
ELECTRIC SEMAPHORE.

No. 445,653. Patented Feb. 3, 1891.



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(No Model.) 8 Sheets—Sheet 5.

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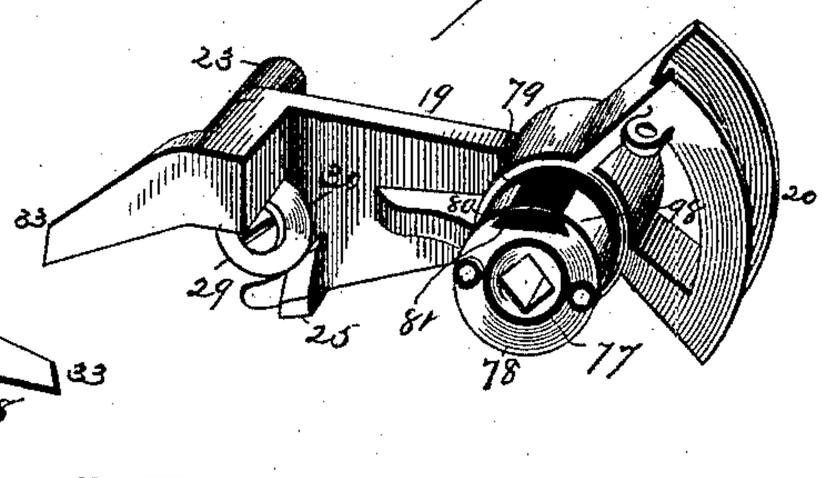
ELECTRIC SEMAPHORE.

No. 445,653. Patented Feb. 3, 1891.

Fig. 10.



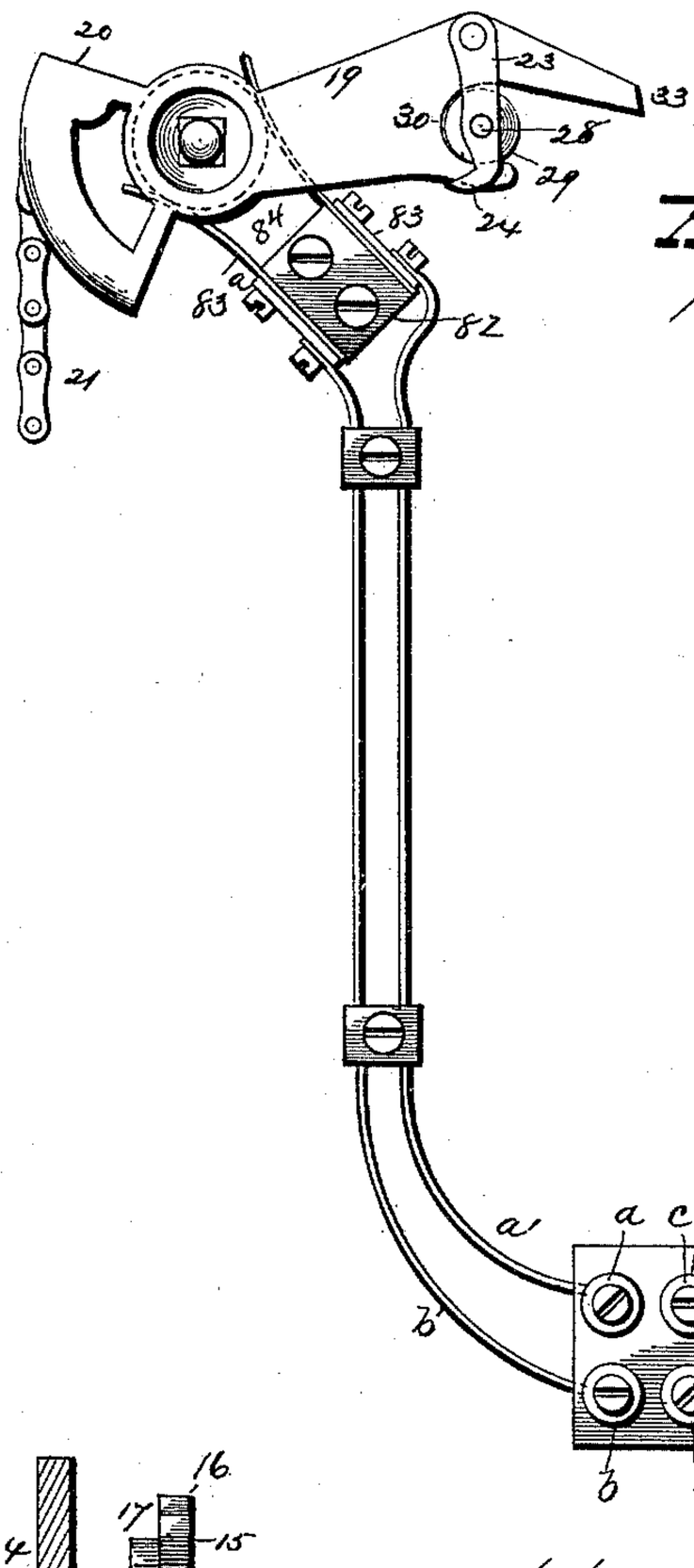
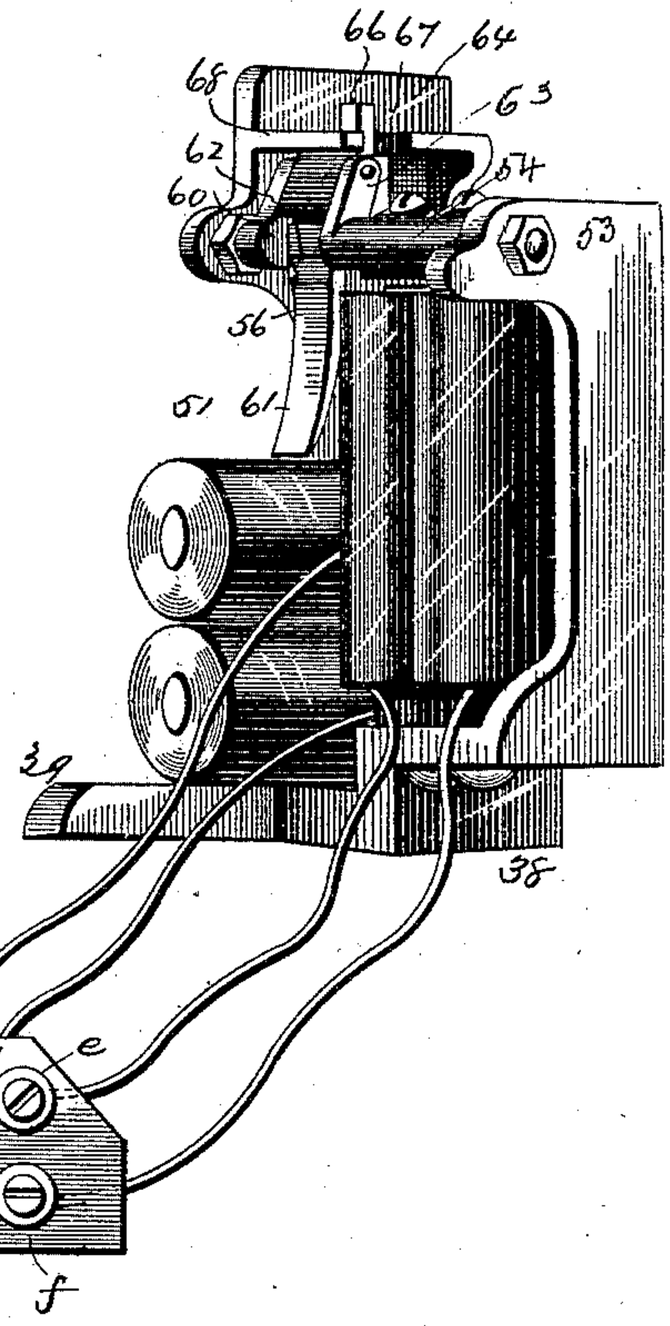
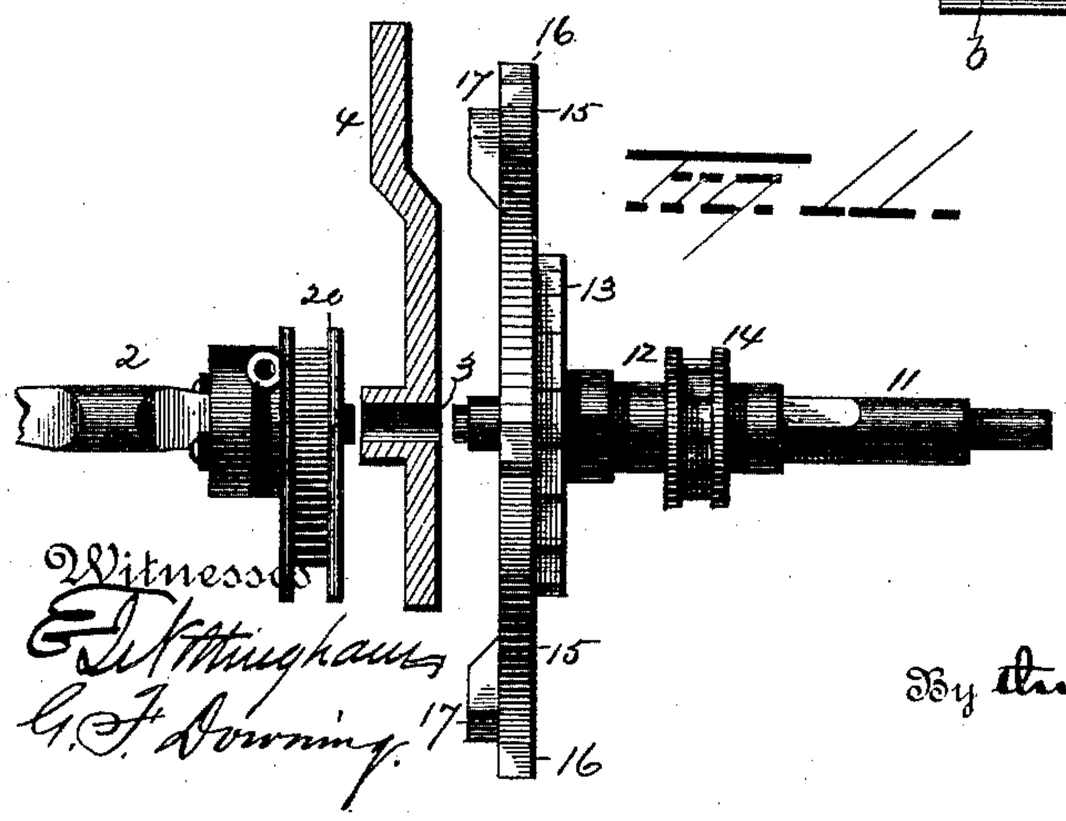


Fig. 5.





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(No Model.) 8 Sheets—Sheet 6.

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ELECTRIC SEMAPHORE.

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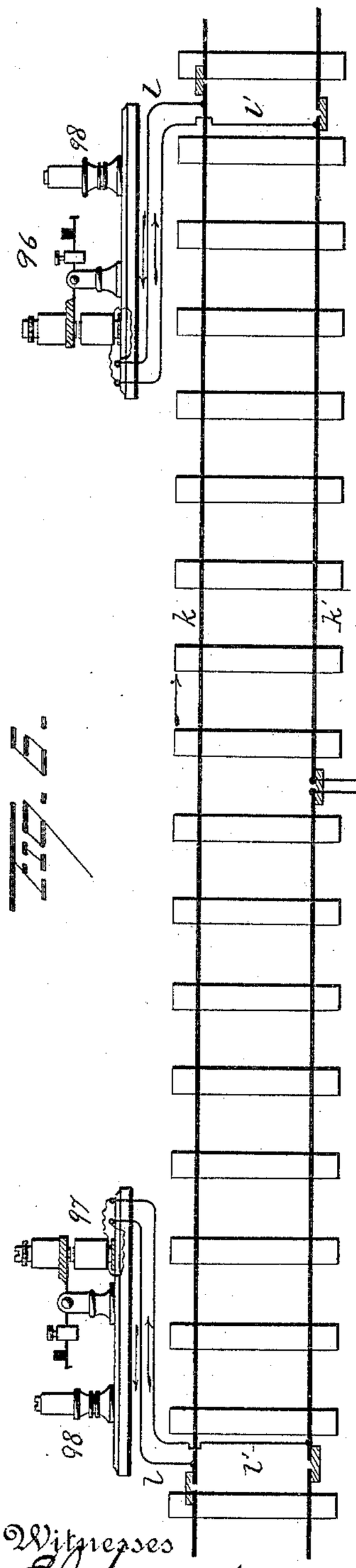

Fig. 6.

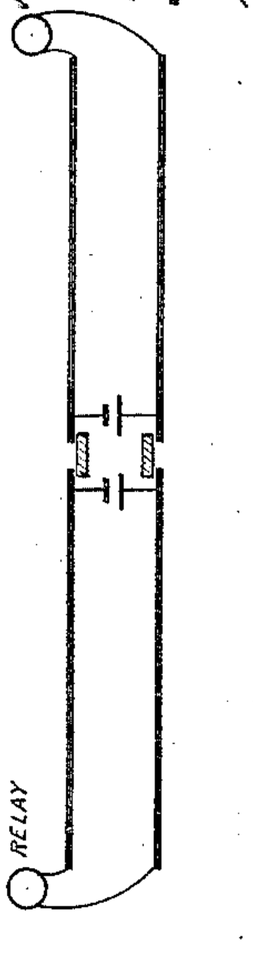

Fig. 6a.

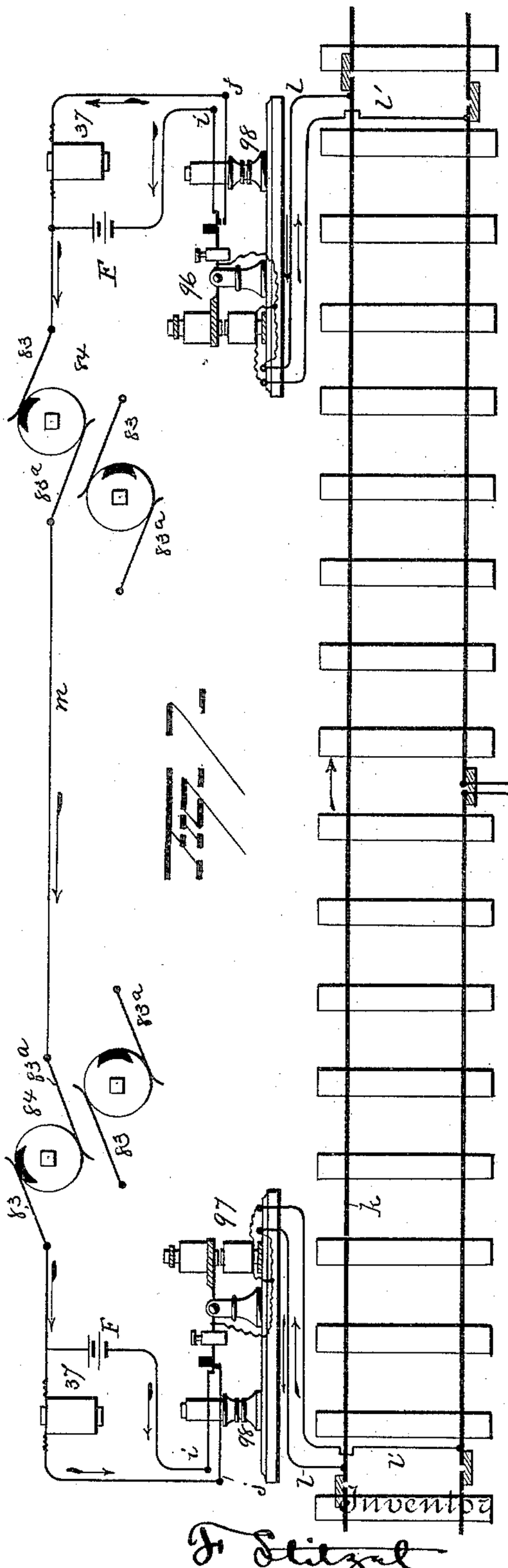

Fig. 7.

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(No Model.)

8 Sheets—Sheet 7.

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ELECTRIC SEMAPHORE.

No. 445,653. Patented Feb. 3, 1891.

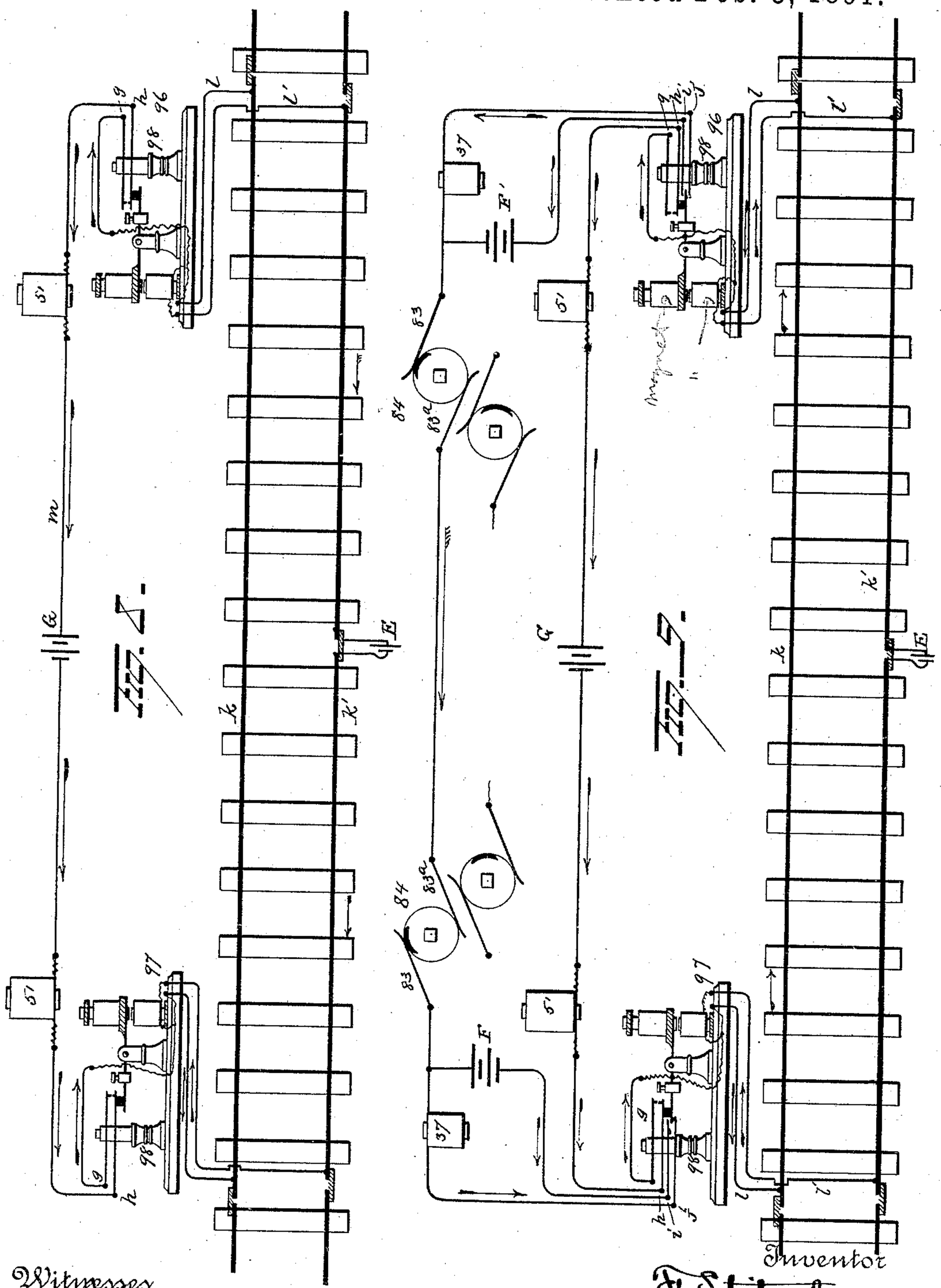

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

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(No Model.)

8 Sheets—Sheet 8.

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ELECTRIC SEMAPHORE.

No. 445,653. Patented Feb. 3, 1891.

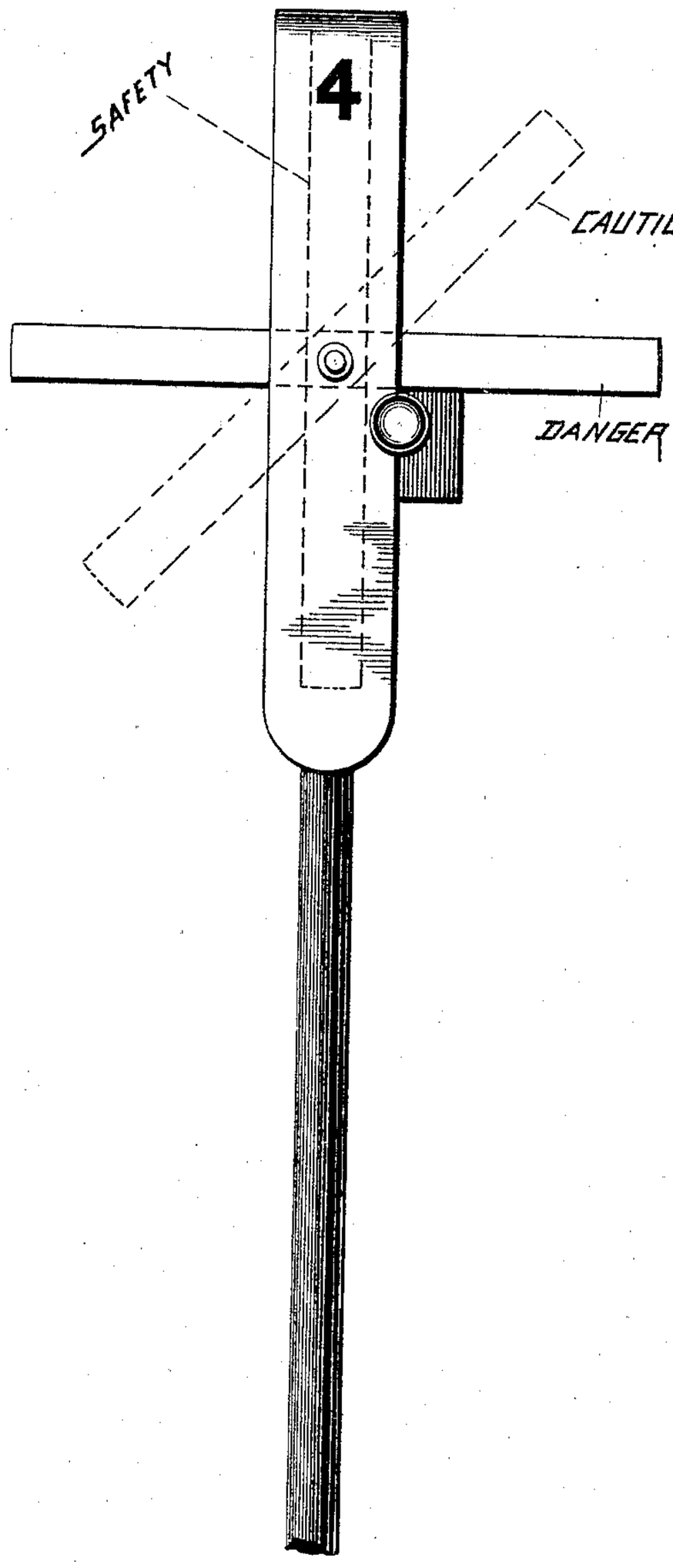

FIG. 2.

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UNITED STATES PATENT OFFICE.

FREDERICK STITZEL AND CHARLES WEINEDEL, OF LOUISVILLE, KENTUCKY, ASSIGNORS TO THE AMERICAN SEMAPHORE COMPANY, OF SAME PLACE.

ELECTRIC SEMAPHORE.

SPECIFICATION forming part of Letters Patent No. 445,653, dated February 3, 1891.

Application filed December 21, 1889. Serial No. 334,570. (No model.)

To all whom it may concern:

Be it known that we, FREDERICK STITZEL and CHARLES WEINEDEL, of Louisville, in the county of Jefferson and State of Kentucky, have invented certain new and useful Improvements in Electric Semaphores; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to an improvement in electric railroad signals or semaphores and a system of circuits therefor.

The object of our present invention is to provide a railroad-block at each end with a semaphore, said semaphores being electrically connected with each other and with the track in such a manner that when a train enters the block from either direction the semaphore at the entrance of the block will be set to indicate "caution" and the semaphore at the exit end of the block set to indicate "danger," the proper operation of the semaphore at the entrance of the block depending upon the proper operation of the semaphore at the exit end of the block, whereby the engineer of a train entering the block will be informed whether or not the semaphore at the exit end of the block has properly operated.

With this object in view our invention consists in certain novel combinations and arrangements of parts and combinations and arrangements of circuits, as hereinafter set forth, and pointed out in the claims.

In the accompanying drawings, Figure 1 is a view of the device with the rear plate removed to show the operating mechanism, said mechanism being in position to hold the signaling devices at "safety." Fig. 2 is a similar view with the parts in the positions they assume when the signal-blade is set to indicate "danger." Fig. 3 is a view showing the positions of the parts when the device is set to indicate "caution." Fig. 4 is a front view of the device with a portion of the frame-work removed. Fig. 5 is an enlarged view illustrating the arrangement of circuits within the head A. Fig. 6 is a view illustrating the track-circuit. Fig. 6^a is a modification of the track-circuit. Fig. 7 is a view illustrating the caution-circuit. Fig. 8 is a view illustrating the semaphore-circuit. Fig. 9 is a view illustrating all the circuits. Figs. 10 and 11 are views of certain details. Fig. 12 is a view illustrating the arrangement of the shield.

A represents the head or frame for containing the operating mechanism and is supported at a suitable height on a hollow post or upright B, both of said parts being preferably made of metal.

Secured to one face of the head A is a diagonally-disposed yoke C, having a screw-threaded boss at its center for the reception of a similarly-threaded screw 1, the inner end of which is made hollow to produce a bearing for one end of a shaft 2. The shaft 2 passes through the wall of the head A and is journaled at its rear end in a perforation 3 in a bracket or hanger 4, secured to a projection on the interior of the head A. Secured upon the shaft 2 (which is preferably made square throughout the greater part of its length) at a point between the diagonal arm of the yoke C and the wall of the head A is a signal blade D, which, when made to assume a vertical position, is designed to indicate "safety," when in a diagonal position to indicate "caution," and when in a horizontal position to indicate "danger." One end of the blade will preferably be provided with a weight 5 to co-operate with other devices hereinafter described to bring the blade to "danger." To prevent the signal-blade from coming into contact with the iron yoke and becoming marred thereby a block of rubber 6 will be secured in a hollow projection 7, secured to one edge of the signal-blade, said block of rubber or other elastic material being adapted to engage the yoke C when the signal-blade assumes a horizontal position.

The signal-blade D will preferably be painted red, and when in a vertical position will be inclosed in a vertical shield D′, secured to the head A. This shield is of a size to inclose and protect the blade D when the latter is in a vertical or safety position and is painted white, so that when the blade is in the vertical or safety position a white signal will be

displayed. The front face of the head is provided with an opening 8, in which is placed a plate of white glass, such as is commonly used in signal-lanterns. A shaft 9 is journaled between the front and rear walls of the head A, above the openings 8, and provided with a depending arm 9^a, which terminates at its lower end in a holder 9^b, preferably elliptical in shape, adapted to receive two plates of colored glass or other colored transparent material, one plate being red and the other green. A lug 9^c projects from the depending arm 9^a, and is adapted to engage the wall of head A, and thus limit the movement of the hanger and hold it squarely behind the opening 8. A lamp is placed in the head behind the opening 8. When the holder containing the colored material swings back from the opening 8 by means of mechanism hereinafter described, a white light will be displayed to indicate "safety." When that portion of the holder containing the green glass is behind the opening 8, a green light or caution-signal will be displayed, and when the red-glass plate is behind the opening 8 a red light will be displayed to indicate "danger."

The rear wall of head A is provided with a perforation in line with the perforation of bracket 4 for the reception of a screw, said screw being made hollow throughout a portion of its length to form a bearing for one end of a shaft 11. The opposite end of the shaft 11 has its bearing in the perforation 3 of hanger 4. By thus journaling the shafts 2 11 in the bracket 4 one shaft can rotate independently of the other. Fixed on the shaft 11 is a collar 12, having a ratchet-wheel 13 secured thereto near its inner extremity and a sprocket-wheel 14 at or near its opposite end for the reception of a sprocket-chain and weight, as explained farther on in this description.

Loosely mounted on the shaft 11, immediately in rear of the ratchet 13, and of considerably larger size than the same, is a toothed wheel 15, having four teeth or projections 16 projecting from its periphery at equidistant points. On the rear face of the wheel 15, slightly removed from the periphery thereof, and in line or approximately in line with the projections 16, is a series of lugs 17, equal in number with said projections. The opposite face of wheel 15 has pivoted to it a dog 18, adapted to engage the teeth of the ratchet-wheel 13 and cause said wheels to rotate together when the shaft 11 is turned in one direction and to ride over said teeth and prevent rotation of the wheel if the shaft turns in the reverse direction, said dog being held in engagement with the ratchet-wheel by means of a spring 18^a, secured at one end to the face of the wheel and bearing at its other end upon said dog.

Fixed upon the shaft 2 is a double arm 19, having a quadrant 20 fixed thereto at one end, said quadrant preferably having one face goooved for the reception of a rope or chain 21, secured thereto at its upper end, a weight 22 being suspended at the free end of the rope or chain 21. The opposite end of the arm 19 from the quadrant 20 is broadened and has pivoted to one of its side faces at one end of the broadened portion a pivoted latch 23, which lies parallel with the face of arm 19 and extends to the opposite end of the broadened portion thereof, where it is provided with a hook 24, adapted to engage the lugs 17 of wheel 15. Thus when the wheel 15 is rotated its engagement with the double arm 19 will cause said arm and its shaft, to which it is made fast, to turn and change the position of the signal-blade D. A lug 25 is made to project from the double arm 19 at a point near the broadened end thereof and adapted to engage a stop 25^a, projecting from the wall of the head A, whereby the rotation of the double arm in one direction is limited, for a purpose which will hereinafter appear.

In order that the depending arm 9^a, carrying the colored material, may move in unison with the signal-blade, it is connected by a rod 26 with the quadrant 20 of arm 19, said rod being secured at one end to a pin projecting from the rear face of the arm 19 and at the other end to a short arm 27, projecting from the hanger-arm 9^a.

Passing transversely through the pivoted latch 23 and projecting from the rear side thereof is a pin 28, which forms the journal for a small roller 29, for the accommodation of which a recess 30 is cut in the lower end of the double arm 19. A semicircular plate 31, having a laterally-projecting arm 32, is pivoted at the upper extremity of the arm 32 to an enlargement formed in the upper part of the head A. The plate 31 extends downwardly parallel with the arc of a circle described by the broadened end of the double arm 19 and serves as a track upon which the roller 29 runs, and thus prevents the improper disengagement of the latch 23 from the lugs 17 of wheel 15.

Projecting from the broadened end of double arm 19 is an outwardly and slightly downwardly extending arm 33, adapted to engage a lever 34, pivoted at or near its center to the head A. The lever 34, where it is pivoted to the head, is preferably enlarged, as shown in Figs. 1 and 2, and provided on its inner edge at such enlarged portion with a plate 35, preferably of steel. The inner edge of the lever 34, from its pivotal point to its upper end, is preferably curved, so that the arm 33 of double arm 19 may readily move over it with as little friction as possible, the free end of the arm for this reason being somewhat beveled. To the lower end of the lever 34 is secured an armature 36, adapted to be attracted by an electro-magnet 37. The electro-magnet 37 is carried by a stand 38, secured to the head A, an arm 39 of the stand projecting beyond the poles of said magnet and below the lower end of the lever 34. A spring-plate 40 is secured at one end to the

lower end of lever 34, and, projecting beyond the lower end of the lever, is adapted to engage the arm 39 of stand 38, so that when the magnet 37 is demagnetized to release the armature 36 the plate-spring 40 will act to force said armature away from the poles of the magnet and thus prevent "sticking."

When the signal-blade is in the horizontal or danger position, as shown in Fig. 2, the double arm 19 will be in the upper extremity of its throw, the arm 33 bearing against the pivoted lever 34 at or near its upper end, thus holding the armature 36 some distance away from and out of the magnetic field of the cores of electro-magnet 37. When the broadened end of the double arm 19 moves to the lower extremity of its throw, the arm 33 will move out of contact with the lever 34, and, the lower end of said lever being heavier than the upper end, the armature 36 will be brought within attractive distance of magnet 37. During this movement of the double arm 19 the signal-blade and night-signal connected therewith will have turned to a vertical position or "safety," as shown in Fig. 1. Assume now that the broadened end of the arm 19 is at the lower extremity of its throw, and the signaling devices are in position to indicate "safety," and the armature 36 within attractive distance of the magnet 37, the electric circuits being arranged as hereinafter explained. Under these conditions when a train enters the block or section the double arm 19 of the semaphore at the exit end of the block will be released and turn to the upper extremity of its throw and thus permit the signal-blade to assume a horizontal or danger position. During this movement of the double arm the arm 33 will engage the pivoted lever 34, or rather the steel plate 35 secured thereto at a point just above its pivot and turn said lever on its pivot and cause it to assume the position illustrated in Fig. 2.

The magnet 37 of the semaphore at the entrance of the block will be energized when a train enters the block, the armature of said magnet attracted, and the pivoted lever maintained in a vertical position. Under these conditions when the arm 33 of double arm 19 engages lever 34 said lever will not turn to allow the double arm to pass, but will retain the double arm at a point midway of its throw. Thus the signal-blade will be made to assume a diagonal or cautionary signal, and a green night-signal will be displayed, as shown in Fig. 3. When the train advances a certain distance on the block, the magnet 37 will become demagnetized, the pivoted lever 34 released, the double arm 19 permitted to pass, and the signal-blade and night-signal made to assume the danger position. Secured to the interior wall of the head below the wheel 15 is a bracket 41, between the arm 41^a of which and the wall of the head a fixed shaft 42 is located. Loosely mounted near its inner end upon the shaft 42 is a lever 43, which comprises a rear broadened portion 44, two side arms, and a forwardly-projecting arm 46. Perforations are made at or near the center of the broadened portion of the lever for the accommodation of the shaft 42. A recess or opening 47 is made in the portion 44 of the lever 43 at one side of the longitudinal axis of said lever and in line with the peripheral projections of the wheel 15. Journaled in this recess or opening 47, in rear of and preferably above the fulcrum of lever 43, is a small roller 48, with which the peripheral projections 16 of wheel 15 are adapted to engage and vibrate the lever in one direction. Connected with the lever 43 is a link 50. The opposite end of link 50 is pivotally connected with the lower extremity of the curved plate 31. The downward movement of the lever will be limited by its engagement with the bracket 41.

Magnets 51 are placed preferably on the stand 38, which stand is provided with uprights 53 at each end, projecting somewhat above the tops of the cores of the magnets, where they are perforated for the reception of screws or pins, which serve as bearings for a shaft 54. This shaft is provided with a flat under face immediately over the magnet-poles for the reception of a soft-iron armature 55, the longitudinal edge of which projects beyond the shaft and by means of which the shaft is given an oscillatory movement in one direction through the medium of the magnets 51. When the magnets 51 are demagnetized, the armature is of course released and the shaft is caused to oscillate in the opposite direction by means of an adjustable weight 56 on an arm 57, projecting from the shaft 54 in the opposite direction from the armature 55. The two standards 53 may be connected by a bar for maintaining them in a rigid position.

Near one end the shaft 54 is provided with a notch 60 directly in the path of the free end of arm 46 of lever 43. Projecting downwardly from the shaft 54 in rear of the notch or recess 60 is a slightly-curved arm 61, terminating at its upper end and at the base of the notch or recess 60 in a shoulder 62, upon which the free end of arm 46 of lever 43 rests when the parts are in their normal positions and the magnet 51 is energized to attract its armature 55.

Secured to the shaft 54 at opposite sides of the recess 60 are two uprights 63. Pivoted between these uprights 63 by two corners is a block or detent 64, having a flange 65 depending from one edge thereof, adapted to engage the shaft 54 and thus limit the vibration of the detent 64 in one direction. A short arm 66 projects upwardly from the top face of detent 64 and passes through a recess 67 in the end of an arm 68, projecting from the stand 38.

The free end of arm 46 of lever 43 is adapted to engage the under surface of the block or detent 64 when the parts are in the danger positions and the magnet is demagnetized to release its armature. By this construction a

broad bearing for the lever is afforded by the detent 64, whereby said lever is prevented from upward vibration at an improper time.

At the base of the hollow post B a bracket 69 is located, which comprises angle-bars 70 71 and web 72. An arm 73 is bifurcated at one end to embrace the web 72, to which it is pivotally connected. At a point near its end the arm 72 is provided with an elongated opening 73ª, and in this opening a grooved pulley is journaled. The free end of arm 73 is provided with a weight 75, for a purpose which will be presently explained. A drive-chain passes about this pulley 74 and is secured at one end to the lower end of a weight 76. The other end of the drive-chain is then carried up into the head A and passed over the sprocket-wheel 14, and the free end of the chain is fixed to the upper end of the weight 76, thus making in effect an endless drive-chain with an interposed weight. By mounting the pulley 74 in a weighted pivoted arm, as above explained, it will be seen that the drive-chain will be always kept taut and that differences in the length of the drive-chain caused from expansion and contraction thereof, due to variations of temperature, will be compensated for by the weighted vibratory arm 73.

Secured to the upright arm of the bracket 69 is a horizontal bracket 85, projecting at each end beyond the upright arm of bracket 69. One end of the bracket 85 is bifurcated for the accommodation of the drive-chain and the other end has secured to it a plate 86, of insulating material. Secured at one end upon the plate 86 is a spring-plate 87, which projects outwardly to a point in proximity to the forked end of the bracket 85, where it is provided with a yoke 88, of insulating material, said yoke conforming in shape and in size with the bifurcated end of bracket 85. A plate 89, of insulating material, is placed upon the rear end of spring-plate 87, and upon this insulating-plate 89 a metallic arm 90 is secured. On the under face of arm 90 and at the free end thereof a contact-point 91 is fixed and adapted to make contact with a similar point 92 on the upper face of spring-plate 87. A block of insulating material 93 is secured upon the plate 86 and carries two binding-posts 93ª, the spring-plate 87 being electrically connected with one of said binding-posts and the metallic arm 90 electrically connected with the other binding-post 93ª.

The binding-posts 93ª are connected in the main semaphore-circuit, so that when the weight runs down it will engage the yoke 88 and separate the contact-point of spring-plate 87 from the metallic arm 90, thus breaking the circuit and causing the semaphores to fall to "danger." The movement of the yoke 88 when the weight strikes it will be limited by the forked end of bracket 85, which will support it.

Secured upon the shaft 2, just within the head A, is a ring 77, of insulating material, and around the ring 77 a metallic ring 78 is placed and separated from contact with the double arm 19 by means of a ring 79, of insulating material. A short recess 80 is cut in the periphery of the metallic ring 78, and a block 81, of insulating material, secured in said recess.

A block 82, of insulating material, is secured within the head A in proximity to the shaft 2. To opposite edges of the block 82 contact-springs 83 83ª are secured, the free ends of said springs being adapted to bear on the periphery of the metallic ring 78 at diametrically opposite points. Thus a circuit-closer 84 will be produced, by means of which an electric circuit is made and broken as the shaft 2 turns in one or the other direction, as will be made clear farther on.

A block 94, of insulating material, is placed at a convenient point within the head A and provided with a series of six binding-posts *a b c d e f*. With the binding-posts *a b* the contact-springs 83 83ª are electrically connected by means of wires *a' b'*. The respective ends of the helices of the magnet 37 are connected with the binding-posts *c d*, and the respective ends of the helices of the magnet 51 are connected with the binding-posts *e f*.

The devices above described for causing the display of the safety and danger signals are fully described, shown, and claimed in Letters Patent No. 417,526, granted to us on the 17th day of December, 1889, and are herein shown and described for the purpose of showing their relation to the devices for causing the display of the cautionary signal.

The apparatus being constructed as above described, the electric circuits are arranged in the manner now to be described.

The railroad-rails are divided into blocks or sections separated from each other by insulating-blocks 95. Located at opposite ends of each block or section is a relay 96 97, preferably of the general construction illustrated in Letters Patent granted to us bearing date the 28th day of September, 1888, and numbered 389,337, each of said relays comprising, in addition to the usual electro-magnets, a pivoted lever carrying at one side of its fulcrum an electro-magnetic armature and at the other side of its fulcrum a counterbalance-weight. Located upon each relay base or stand and comprising a part of the relay apparatus is a post or holder 98, of insulating material, adapted to receive and hold a series of contact-springs *g h i j*. The free end of the lever of each relay is adapted to make and break contact with the springs *i j*. A block of insulating material is supported upon the lever of each relay and adapted to engage the contact-spring *h* and force it into contact with the spring *g*. The respective ends of the helices of the relay-magnets of each relay are connected with the rails *k k'* of the block by means of wires *l l'*. At the center of the block or section the rail *k'* is divided by a block of insulating material, and between the rail ends

a battery E is located, its respective poles being electrically connected with the respective rail ends by means of suitable wires. The contact-spring *g* of relay 96 is connected with the wire *l*, leading to the track *k*, while the spring *h* is electrically connected with one end of the helix of semaphore-magnet 51, the other end of said helix being connected by means of wire *m* with one end of the helix of the semaphore electro-magnet 51 of the semaphore at the opposite end of the block, a battery G being included in this circuit. The opposite end of the helix of the latter-named electro-magnet is connected with the contact-spring *h* of relay 97, while the contact-spring *g* of relay 97 is electrically connected with the wire *l*, which leads to the rail *k*. Thus it will be seen that when a train enters the block from the right-hand end the magnet of relay 96 will be cut out of circuit with battery E and that the contact-springs *g h* are allowed to separate and break the circuit, which includes the two semaphore-magnets 51 and battery G. The armatures of the magnets 51 are therefore released and the mechanism allowed to operate to release the signal-blade. When the train enters from the left-hand end of the block, the relay 97 will break the circuit of the main semaphore-magnets.

The third circuit, which controls the caution-signal, is described as follows: The caution-circuit is maintained normally open by means of the circuit-closer 84, as shown in Figs. 7 and 9; but when a train enters the block from the right-hand end and the relay 96 is demagnetized to allow its armature-lever to make contact with the spring-contact point *j* and break contact between spring-plates *g* and *h*, allowing the semaphores to operate the circuit-closer 84, the current will start from the battery F at the left-hand end of the block and flow by means of a suitable wire to the spring contact-plate 83, through the metallic ring of the circuit-closer 84, to the contact-spring 83ª, and thence by line-wire *n* to contact-spring 83ª of the circuit-closer 84 of the semaphore at the right-hand or entering end of the block and through the metallic ring of said circuit-closer to the plate 83. The current then flows by means of a suitable wire through the helix of magnet 37, thence to the spring contact-plate *j*, through armature-lever of relay 96 to wire *l*, and thence through track-rail *k* to wire *l* of relay 97. The current then flows from the wire *l* to the armature of relay 97, thence to contact-spring *i*, and from contact-spring *i* to battery F. When a train enters the block from the left-hand end, the relay 97 will be cut out of circuit with the battery E and its armature-lever permitted to engage the contact-spring *i* of said relay, and the caution-circuit will be as follows: Starting from battery F′ at the right-hand end of the block it will flow, by means of a suitable wire, to contact-spring *i*, thence to armature-lever of relay 96, and thence by suitable wire to wire *l*. The current then flows through rail *k* to wire *l* at the left-hand end of the block, thence by suitable wire to armature-lever of relay 97, thence to contact-spring *j*, from contact-spring *j* through helix of magnet 37 of the semaphore at the left-hand end of the block, thence to contact-spring 83 of circuit-closer 84, through metallic ring of said circuit-closer to contact-spring 83ª, and thence by wire *m* to contact-spring 83ª of semaphore at the right-hand end of the block. From contact-spring 83 the current flows by means of a suitable wire to battery F′.

The three circuits being arranged as above described, when a train enters the block from the right-hand end the relay 96 will be cut out of circuit with the battery E and will remain cut out until the train passes the battery E. The magnet of relay 96 being thus demagnetized, the armature-lever will separate the contact-springs *g h* and break the circuit which includes the semaphore-magnets 51 of both semaphores. Magnets 51 being thus demagnetized, they will release their armature, thus setting free the mechanism which holds the signal at "safety" and permitting both signals to begin to turn to "danger." The armature 55 being released, the shoulder 62 of arm 61 is moved out of the path of the arm 46 of lever 43, and said lever allowed to fall by gravity, the peripheral projection 16 of wheel 15 being held out of engagement with the roller of lever 43 by the engagement of the lug 25 of the arm 19 with the stop 25ª. As lever 43 moves downwardly the semicircular plate 31 is caused to turn on its pivot through the medium of the link 50 and move away from the pivoted latch. The free end of the latch will then become disengaged from the lug 17 of wheel 15. The double arm 19 will now be free to make a partial revolution, being impelled by the weight 22. After the arm 19 shall have been released a peripheral projection 16 of wheel 15 will engage the roller of lever 43 and vibrate the free end of said lever and cause it to engage the detent 64, against which it will bear with a pressure equal to the main weight 76. In the semaphore-head, at the entrance of the block, as soon as the shaft 2, which carries the signal-blade, begins to turn the caution-circuit is closed by the circuit-closers, and the battery F at the left-hand end of the block will be put into circuit with the magnet 37 of the semaphore at the right-hand end of the block, as above explained in the description of the caution-circuit. The magnet 37 of the semaphore at the right-hand end of the block being thus magnetized, it will attract the armature 36 of pivoted lever 34 and retain said lever in a vertical position, so that the arm 33, projecting from the double arm 19, will engage the vertical pivoted lever at a point near its center and be retained midway of its throw, thus retaining the signal-blade in a diagonal or caution position, and the green glass of the night-signal behind the light-emanating open-

ing in the head. When the train passes the battery E, the relay 97 will be cut out of circuit, and the armature-lever of said relay allowed to break contact with the spring *i*, and thus break the circuit through the helix of magnet 37 of the semaphore at the right-hand end of the block. The magnet 37 being thus demagnetized, it releases the pivoted lever 34, and the double arm 19 is permitted to continue its movements to the upper extremity of its throw, at which point the signal devices will have assumed the danger position. When the train leaves the block, the circuit through the main semaphore-magnets will be again established and said magnets made to attract their armatures, whereupon the detent will be again moved out of the path of the lever 43 and said lever permitted to be tilted by the pressure of the projections 16 of wheel 15 sufficiently to permit the passage of one of the projections 16. The catch 23 having engaged another projection 17, the arm 19 will be returned to its normal position by the wheel 15, and the signal made to again assume a vertical or safety position. As another projection 16 engages the lever 43 said lever is brought up into contact with the detent 64, and the lower end of the curved plate 31 returned to its normal position to maintain the catch 23 in engagement with the projection 17 of wheel 15. When a train enters the block from the reverse direction, or from the left-hand end of the block, the signal at that end will assume the caution position and the signals at the right-hand end of the block will assume the danger position, this being accomplished in the same manner as last above described, except that the caution-circuit will be controlled by the relay 97, as explained in the above-detailed description of the caution-circuit. When a train enters the block from either end and the engineer sees the signal set at "caution," he is informed that the signal at the exit end of the block is set at "danger," because, as will be readily understood, it would be impossible for the signal at the entrance of the block to assume the caution position unless the signal at the exit end has moved to "danger." Seeing the caution-signal displayed at the entrance of the block, the engineer knows that he can proceed without danger of meeting a train on that block coming in the reverse direction.

This invention is especially applicable to single-track roads.

It is evident that in lieu of the arrangement of track-circuit above described the arrangement shown in Fig. 6ª may be adopted. In this arrangment the block is in effect divided into two sections insulated from each other, each section being provided with a battery E.

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

1. The combination, with a railroad-block, a relay at each end thereof connected in circuit with the track of the block, and a semaphore-operating mechanism at each end of the block connected in electric circuit with contact-points of the relays, of separate electro-magnetic devices in each semaphore for retaining the signals in a position to indicate "caution," and electric circuits connecting said electro-magnetic devices with contact-points of the relays, whereby said electro-magnetic devices of one semaphore will be switched into circuit when the train enters the block from one direction, and the electro-magnetic devices of the other semaphore will be switched into circuit when the train enters the block from the other direction, substantially as set forth.

2. The combination, with a block of railroad and a relay at each end thereof, the relay-magnets being connected with the tracks, one of said tracks being parted at the center of the block, of a battery having its poles connected with the respective rail ends at the point where the rails are parted and semaphores connected in electric circuit with the relays.

3. The combination, with a block of railroad, a relay located at each end thereof in electric circuit with the rails of the track, and signals at each end of the block electrically connected with the relays, of a circuit-closer controlled by each signal device, and electro-magnetic devices in each semaphore and controlled by the relays, said electro-magnetic devices being constructed and arranged to retain the signal at the entrance of the block at "caution" when a train enters the block from either direction, substantially as set forth.

4. In a semaphore, the combination, with a shaft, a signal-blade, and a weighted arm secured to said shaft, of an electro-magnet and a pivoted lever controlled by said magnet, with which the weighted arm is adapted to engage to limit its movement, substantially as set forth.

5. In a semaphore, the combination, with a shaft, a signal-blade, and a weighted arm secured thereto, of an electro-magnet, an arm projecting beyond the poles of said magnet, a pivoted lever adapted to be engaged by the weighted arm when said lever is maintained in a vertical position, an armature on said lever to be attracted by the magnet, and a spring-plate carried by the pivoted lever and adapted to engage the arm which projects beyond the poles of the magnet and prevent the armature from sticking to the magnet, substantially as set forth.

6. The combination, with a railroad-block, a relay at each end thereof connected in electric circuit with the track, and semaphore-magnets connected in electric circuit with relay contact-points, of a circuit-closer carried by each semaphore, electro-magnetic devices for retaining the signal in a position to indicate "caution," and an electric circuit including the relays, electro-magnetic devices, and circuit-closers, substantially as set forth.

7. The combination, with a railroad-block, a relay at each end thereof connected in electric circuit with the tracks of the block, and semaphore-magnets connected in electric circuit with the contact-points of the relays, of a shaft carrying a signal-blade, a circuit-closer connected with said shaft, electro-magnetic devices for limiting the signal-blade in a position to indicate "caution," and electric circuits including the relays, electro-magnetic devices, and circuit-closers, substantially as set forth.

8. The combination, with a railroad-block, a relay at each end thereof connected in electric circuit with the tracks, semaphore-heads each having a light-emanating opening, and semaphore-magnets connected in electric circuit with the contact-points of the relays, of a shaft carrying a signal-blade and a weighted arm, a night-signal connected with the weighted arm and carrying two plates of transparent material of different colors, a circuit-closer connected with said shaft, electro-magnetic devices for limiting the weighted arm to cause the signal-blade and night-signal to indicate "caution," and electric circuits including the relays, electro-magnetic devices, and circuit-closers, substantially as set forth.

9. In a semaphore, the combination, with a shaft carrying signaling devices, a chain passing over said shaft to drive it, a weight on said chain, operating mechanism, and an electro-magnet for controlling said operating mechanism in a normally-closed circuit, of a pivoted weighted arm carrying a pulley over which said drive-chain is adapted to pass, substantially as set forth.

10. In a semaphore, the combination, with a shaft carrying signaling devices, a chain passing over said shaft to drive it, a weight on said chain, operating mechanism, and an electro-magnet for controlling said operating mechanism in a normally-closed circuit, of a circuit-breaker included in said closed circuit and adapted to be operated by the weight when said weight is run down to open the circuit, and a pivoted weighted arm carrying a pulley over which the drive-chain is adapted to pass, substantially as set forth.

11. The combination, with the tracks of a railroad-block, a semaphore at each end thereof having main electro-magnets and electro-magnetic devices for controlling a cautionary signal, and a relay at each end of the block, of a normally-closed circuit including the track, the relay-magnets, and a battery, a second normally-closed circuit including the main semaphore-magnet of each semaphore, the relays, a rail of the track, and a battery, and a third or cautionary normally-open circuit including the above-mentioned electro-magnetic devices of both semaphores, circuit-closers carried by the semaphores, both relays, a rail of the track, and a battery, substantially as set forth.

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

FREDERICK STITZEL.
CHARLES WEINEDEL.

Witnesses:
H. L. KRIEGER,
JNO. MAAS, Jr.