(No Model.) 5 Sheets—Sheet 1.

E. D. GRAFF.

ELECTRIC SIGNALING APPARATUS FOR RAILWAYS.

No. 448,856. Patented Mar. 24, 1891.

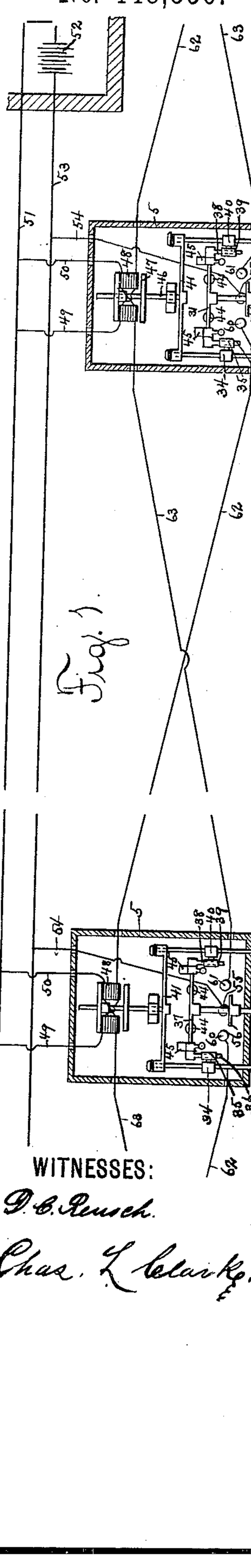

Fig. 1.

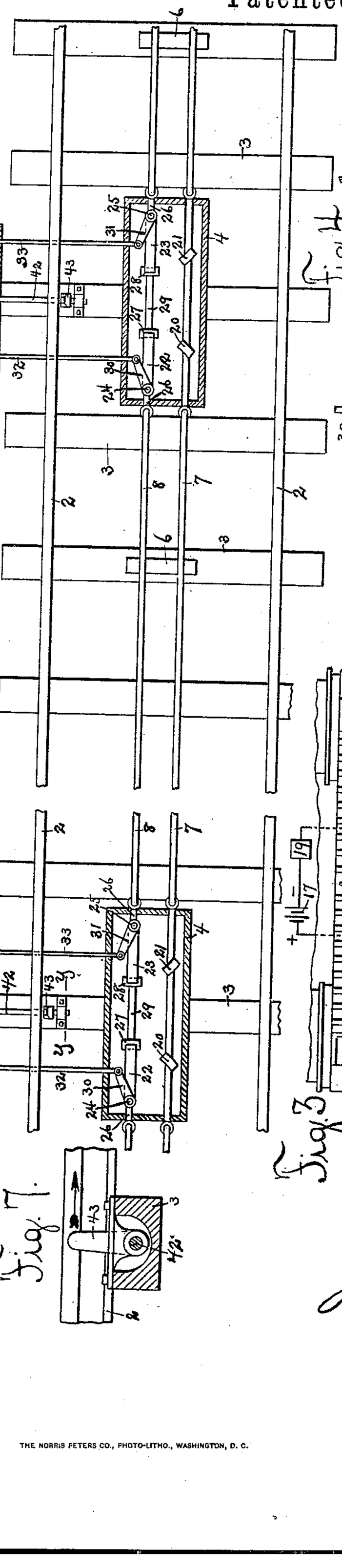

Fig. 2.

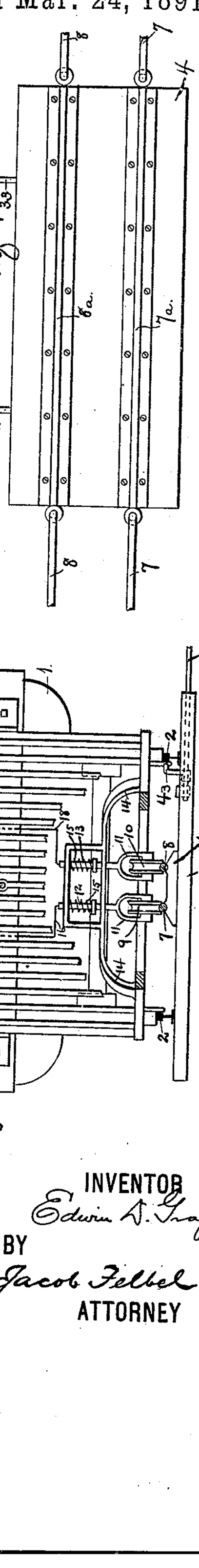

Fig. 4.

Fig. 5.

Fig. 3.

Fig. 6.

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ELECTRIC SIGNALING APPARATUS FOR RAILWAYS.

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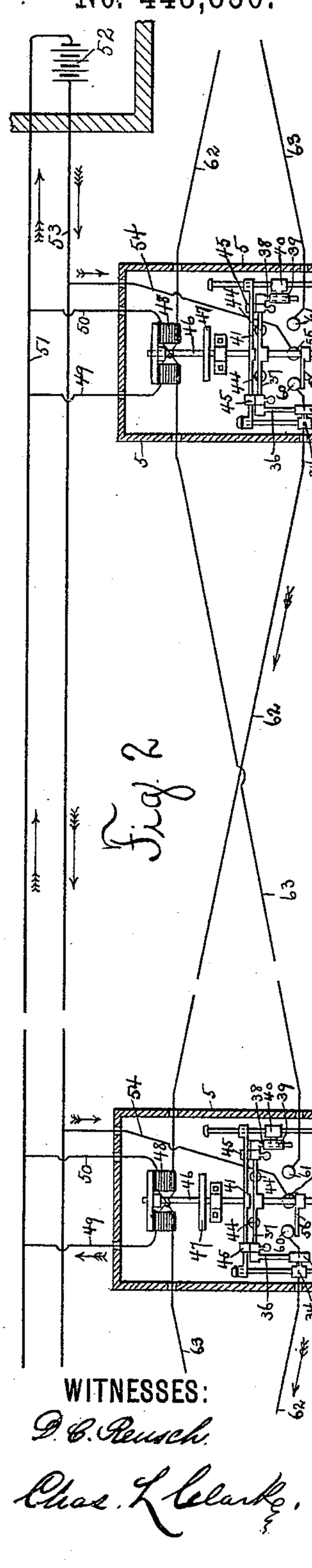

Fig. 2

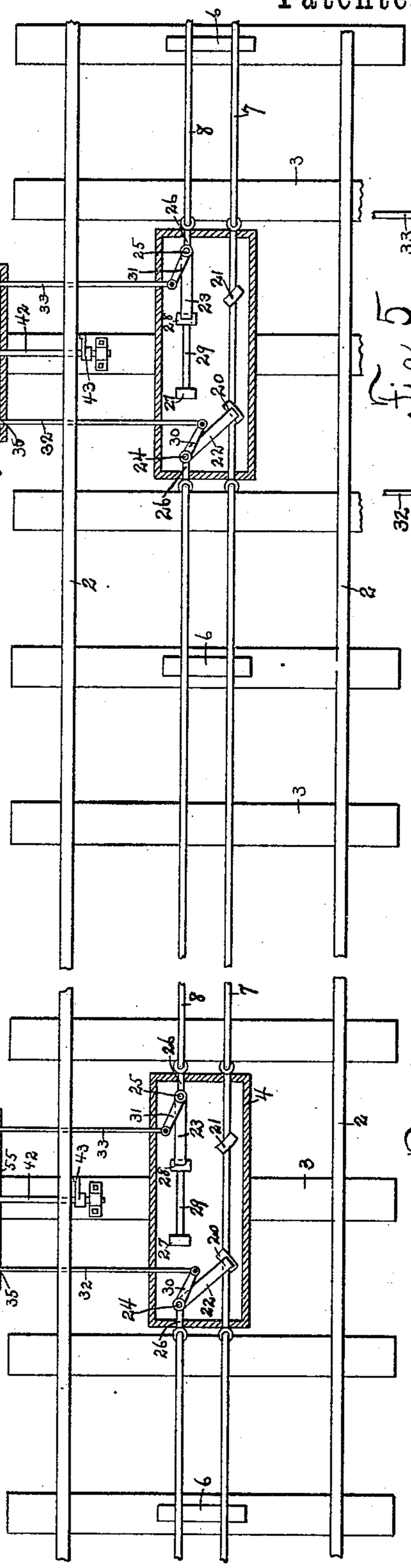

Fig. 5

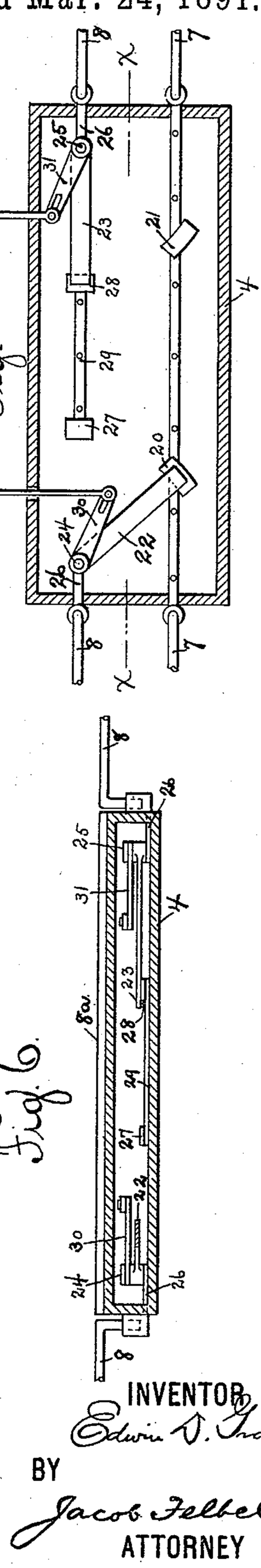

Fig. 6

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E. D. GRAFF.

ELECTRIC SIGNALING APPARATUS FOR RAILWAYS.

No. 448,856. Patented Mar. 24, 1891.

Fig 8.

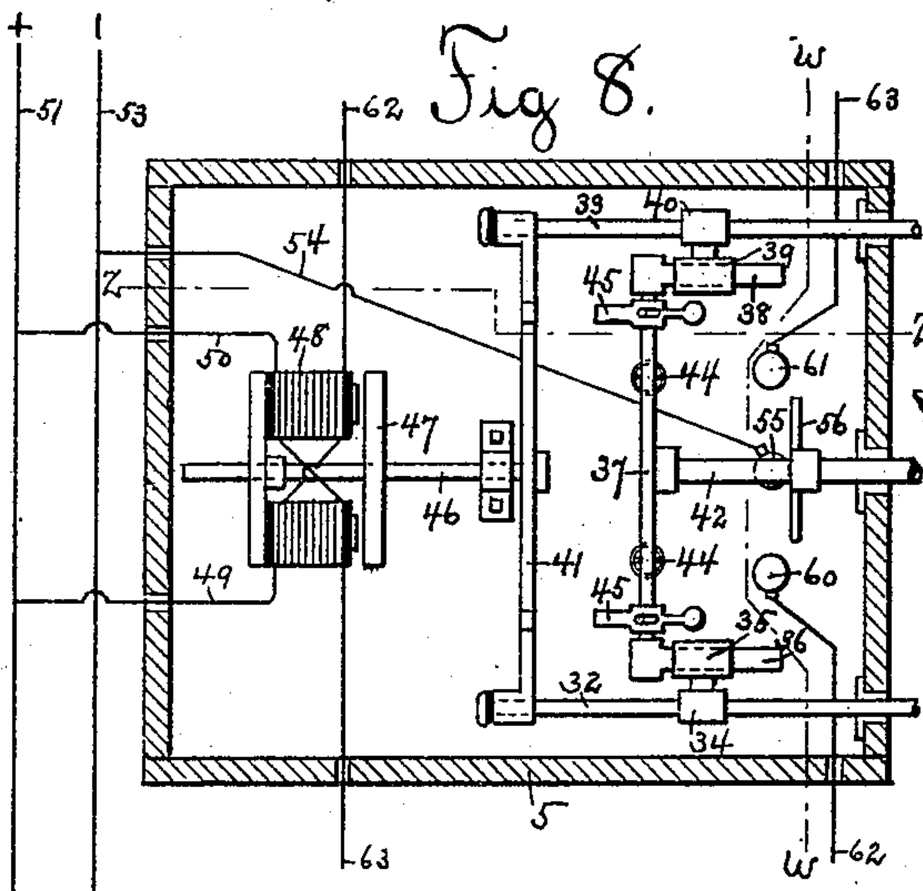


Fig 9.

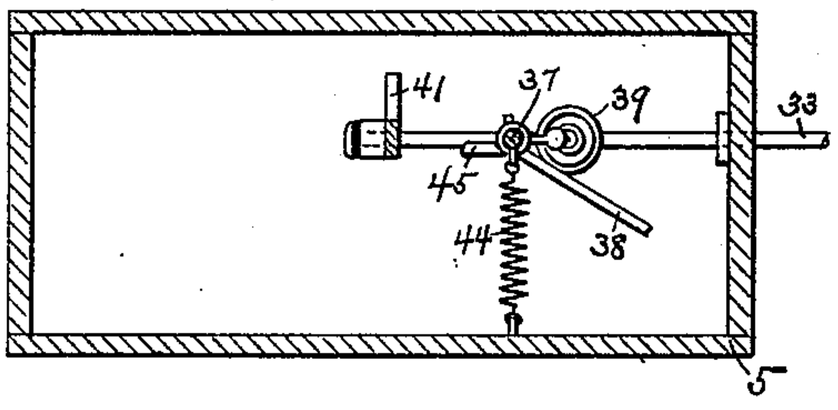


Fig 10.

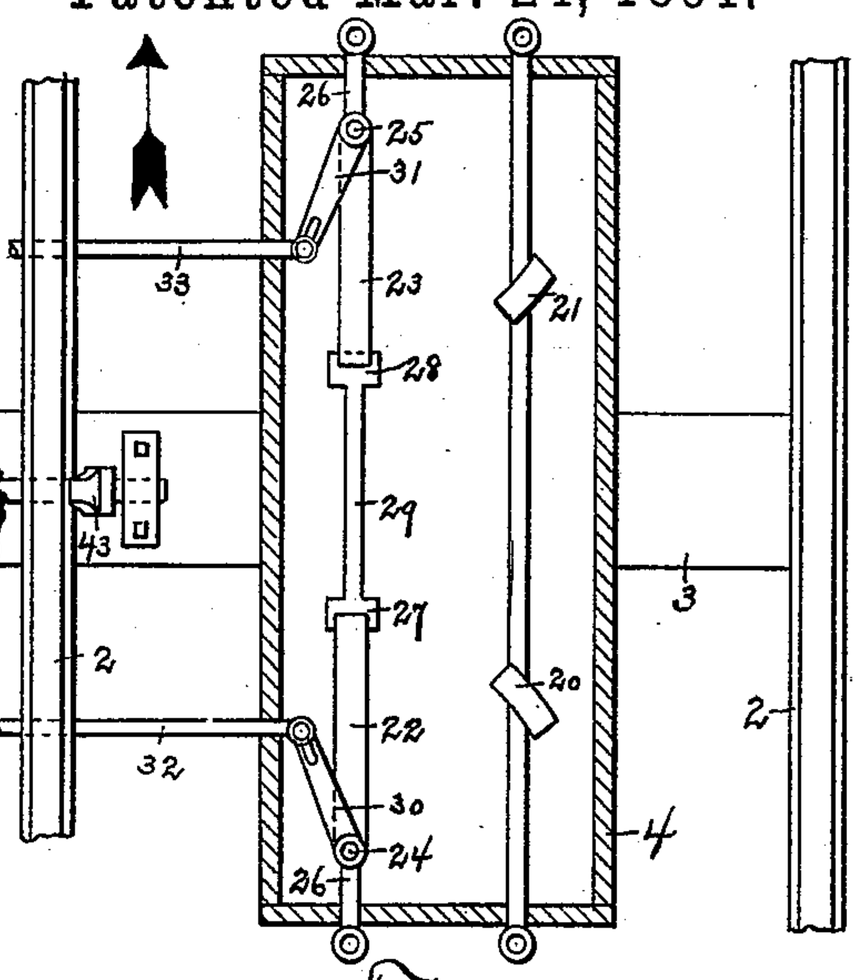


Fig 12

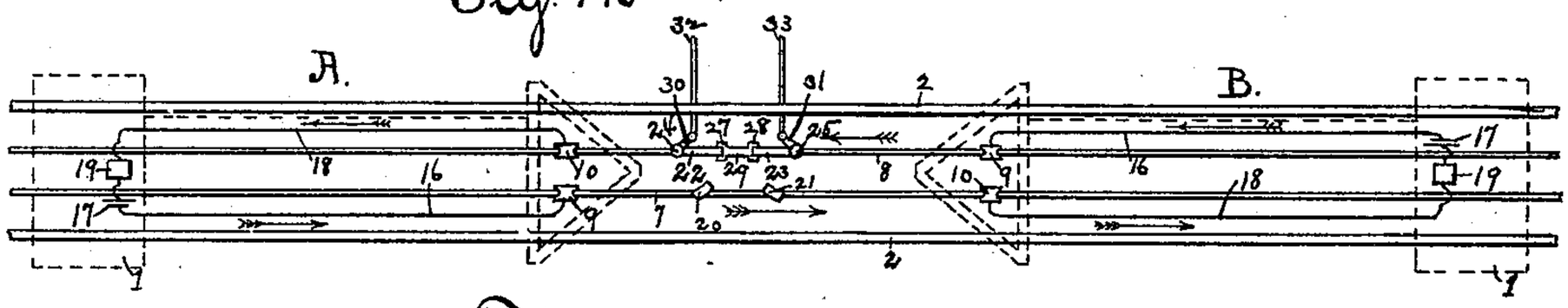


Fig 13.

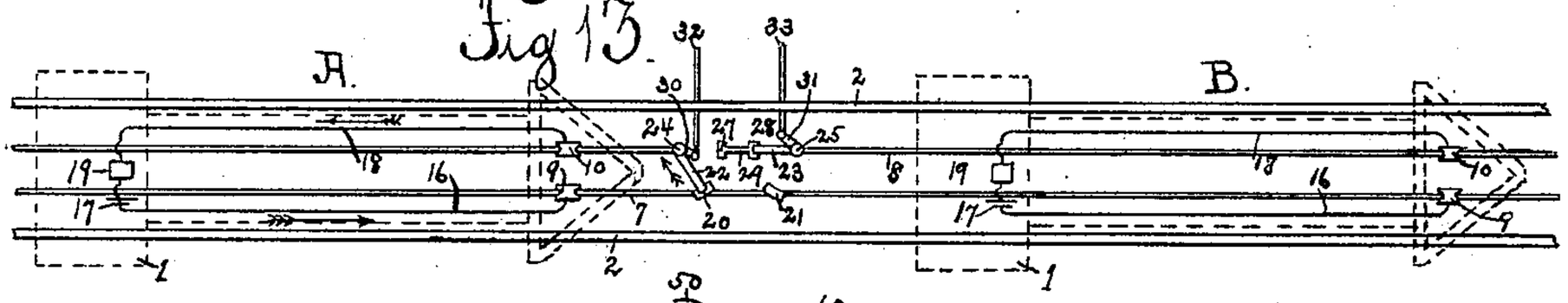


Fig 11

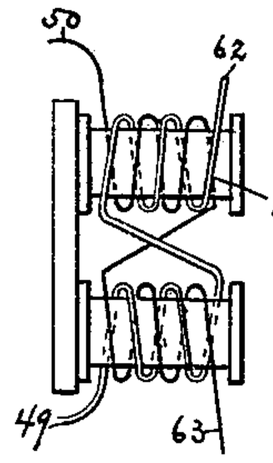
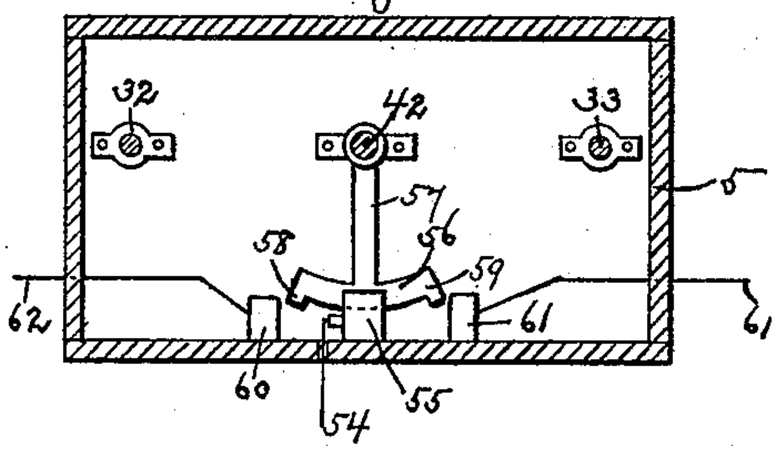


Fig 14



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E. D. GRAFF.

ELECTRIC SIGNALING APPARATUS FOR RAILWAYS.

No. 448,856. Patented Mar. 24, 1891.

Fig. 14.

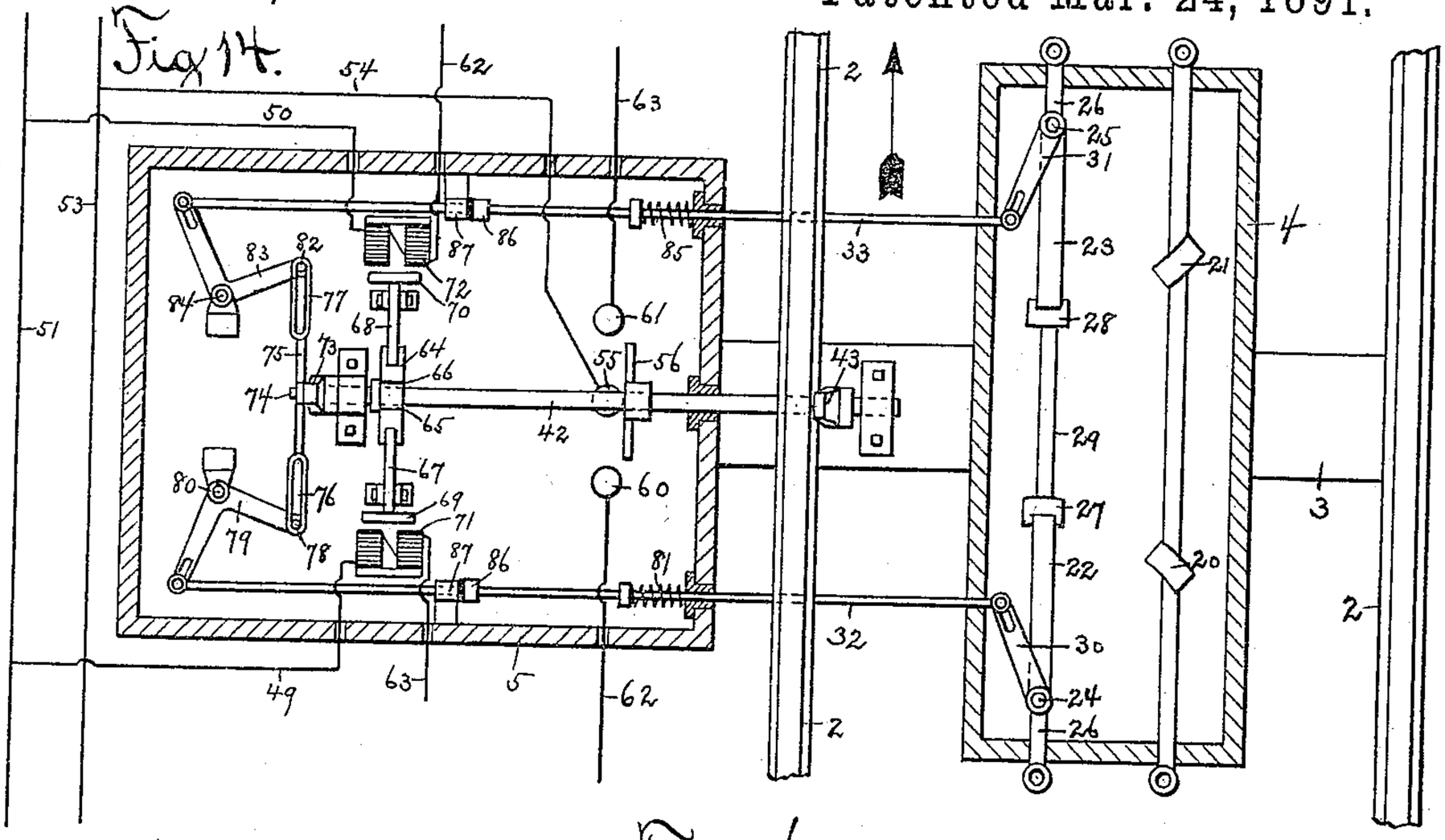


Fig. 16.

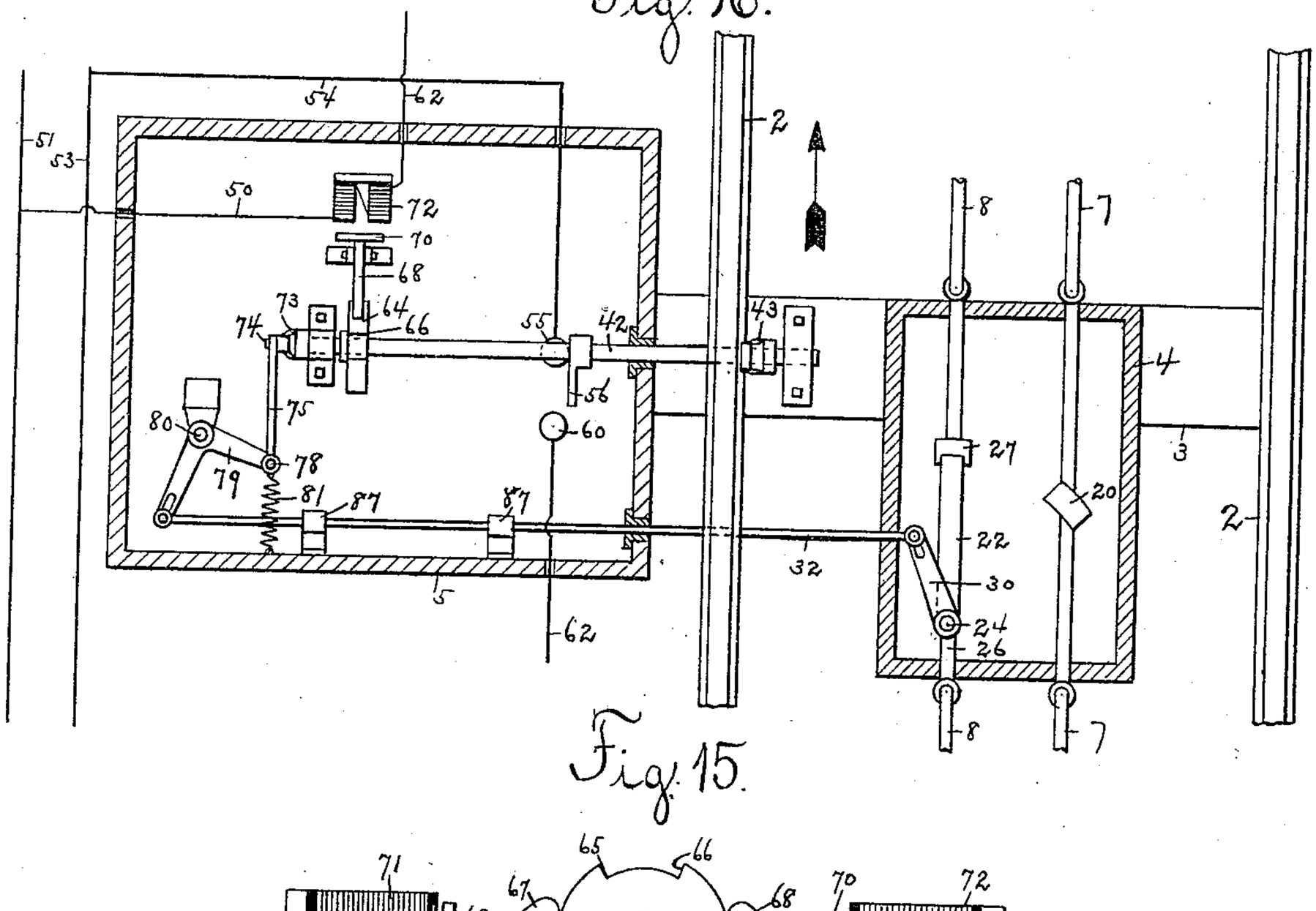
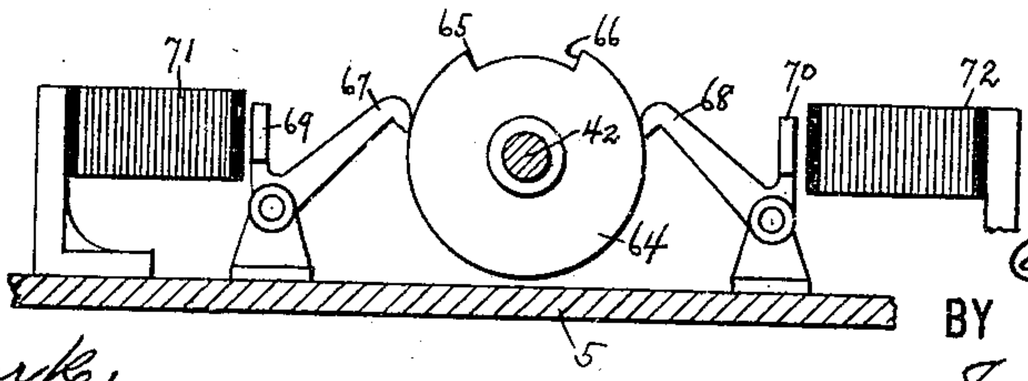


Fig. 15.



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(No Model.) 5 Sheets—Sheet 5.

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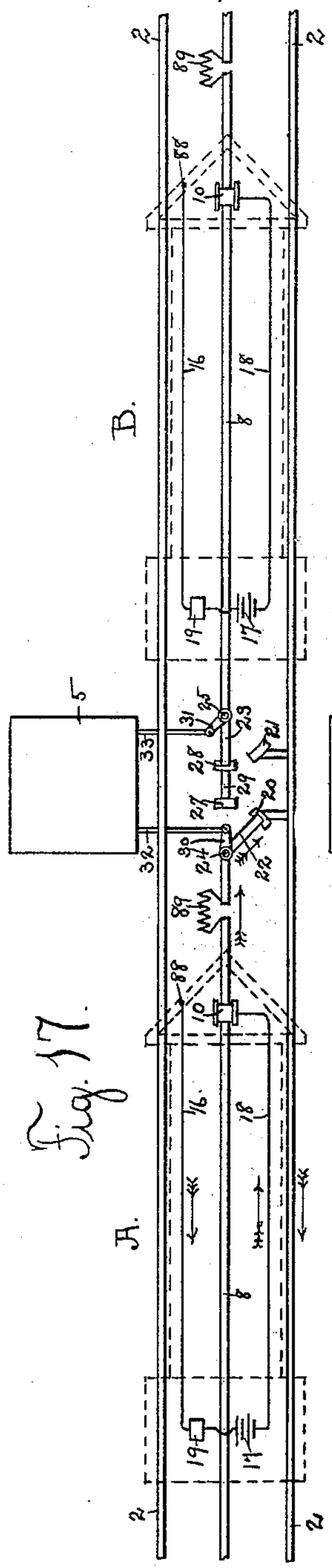

Fig. 17.

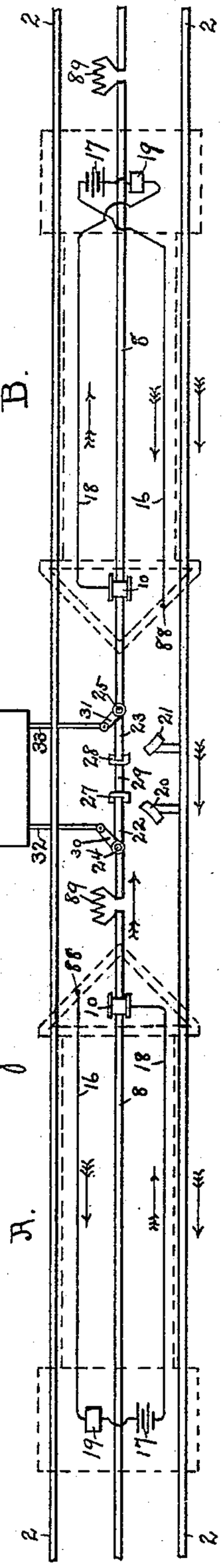

Fig. 18.

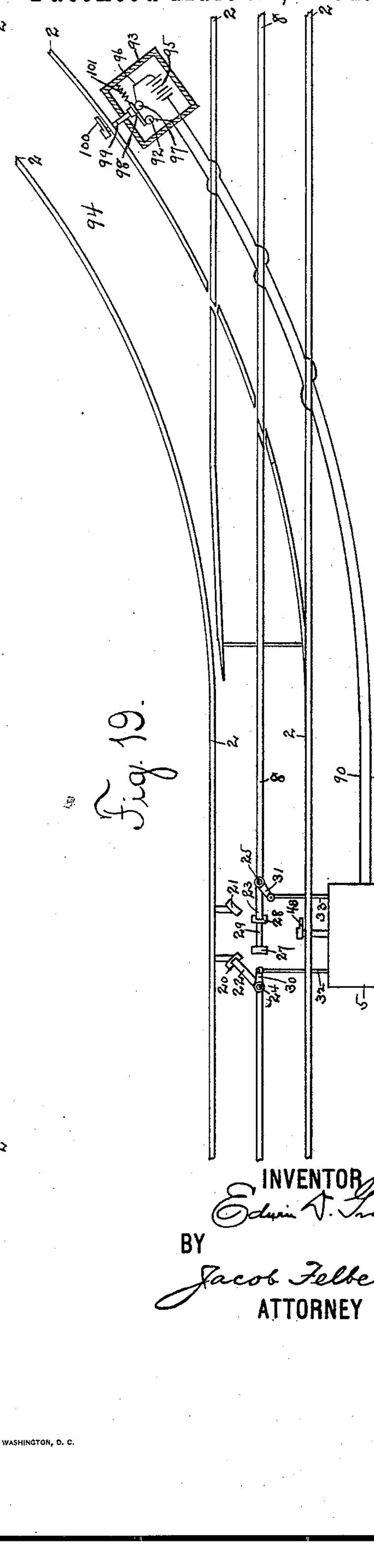

Fig. 19.

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UNITED STATES PATENT OFFICE.

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ELECTRIC SIGNALING APPARATUS FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 448,856, dated March 24, 1891.

Application filed September 29, 1890. Serial No. 366,611. (No model.)

To all whom it may concern:

Be it known that I, EDWIN D. GRAFF, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Electric Signaling Systems for Railways, of which the following is a specification.

My invention relates, first, to means for electrically signaling between two approaching trains on the same track; secondly, for signaling an approaching train when the train immediately preceding it on the same track has stopped or for any other reason has failed to pass out of a prescribed block or predetermined section; thirdly, to means or mechanism whereby the signaling devices are regulated or controlled so as to be operable to give the desired notice to the engineers of approaching trains and to the engineer of a train which may come within a block or section of the track before a preceding train has passed out.

To these ends my invention consists in the means or mechanisms and features of construction and combinations of devices hereinafter more fully described, and particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 represents a plan view, partly in section, of a system or apparatus for signaling between trains embodying some of my improvements. Fig. 2 is a similar view showing the working parts in different positions. Fig. 3 is a front sectional view of a locomotive in action with the cow-catcher broken away to show the bell-circuit. Fig. 4 is a plan view of one of the electric switch-boxes enlarged. Fig. 5 is a plan view of one of the electric switch-boxes with the cover removed. Fig. 6 is a vertical section taken at the line $x\,x$ of Fig. 5. Fig. 7 is a vertical detail section enlarged, taken at the line $y\,y$ of Fig. 1. Fig. 8 is an enlarged plan view, partly in section, to show more clearly the construction and operation of the switch and track instruments shown at Figs. 1 and 2. Fig. 9 is a vertical section taken at the line $z\,z$ of Fig. 8. Fig. 10 is a similar section taken at the line $w\,w$ of Fig. 8. Fig. 11 is an enlarged detail view to show the winding of the magnet of the track-instrument shown at Fig. 8. Fig. 12 is a diagrammatical view to show the mode of signaling between two trains approaching each other. Fig. 13 is a similar view to show the mode of signaling the engineer of a train about to enter a block or section before the train immediately preceding it has passed out from the same. Fig. 14 is an enlarged plan view, partly in section, showing a modification of the apparatus, illustrated more particularly at Fig. 8. Fig. 15 is an enlarged detail view to show the means employed at Fig. 14 for locking the electric switch after the passage of a train until such train shall have released the same electrically on its passage into a new block or section. Fig. 16 is a plan view, partly in section, showing a further modification of the invention for use particularly on double-track roads for the purpose of signaling between two trains on the same track moving in the same direction within dangerous proximity. Fig. 17 is a diagrammatical view illustrating a further modification of my invention, wherein one of the tracks of the railway is employed as a conductor in the electric-bell circuit, and wherein the devices are arranged to signal the engineer of a train approaching one still within a block or section such train is about to enter. Fig. 18 is a similar view illustrating a further modification, wherein the tracks are used as conductors and wherein provision is made for signaling the engineers of two approaching trains upon the same track. Fig. 19 is a plan view illustrating a means whereby a train passing from the main line onto a switch may automatically set the electric switch so as to prevent any alarm-signal being given to the train immediately following when it enters the block or section which the first-mentioned train switched off from.

I shall first describe my improvements with reference to Figs. 1 to 13, inclusive, in which views 1 designates the locomotive; 2, the railway-track; 3, the cross-ties; 4, the electric switch-box, and 5 the track-instrument box.

Lengthwise of the road, suitably secured upon supports 6, mounted on the cross-ties at intervals, are two parallel wires, rods, or conductors 7 and 8, which are preferably arranged midway between the two rails of the track, and which extend the entire length of the same.

At the front of the locomotive, preferably,

are arranged two metallic rollers 9 and 10, which are mounted in suitable supports or brackets 11, provided with vertical stems 12 and 13, fitted to have a slight up-and-down movement in a supporting-frame 14, and provided with spiral springs 15 for the purpose of keeping said rollers or wheels in electrical contact with the parallel rods or conductors 7 and 8. To the upper end of the stem 12 is connected one end of an insulated wire 16, which runs to the positive pole of an electric battery 17, located upon the locomotive, preferably within the engineer's cab, and to the upper end of the stem 13 is connected one end of an insulated wire 18, which passes through an electric bell 19, and runs thence to the negative pole of said battery. The stems 12 and 13 are insulated from the frame 14, so as to prevent any short-circuiting of the current therethrough.

At suitable intervals along the track and preferably between the rails the electric switch-boxes 4 are arranged. Those portions of the road between any two succeeding boxes constitute each a block or section, which may extend in length a mile, more or less. Within each switch-box 4 is arranged a metallic rod, which connects with and is practically a continuation of the conductor 7, and which is provided with two contacts 20 and 21. Within each switch-box 4 are also arranged two switches 22 and 23, pivoted, respectively, at 24 and 25 to metallic portions 26, which connect with and form continuations of the conductor 8. Normally the free ends of the switches 22 and 23 rest, respectively, upon contacts 27 and 28, which are connected together by a metallic section 29.

At the pivots 24 and 25 are mounted cranks 30 and 31, the free ends of which are pivoted to the two parallel sliding rods 32 and 33, which extend transversely outside of the box 4 beneath the rail 2 and into the track-instrument box 5. The rod 32 within the box 5 has rigidly secured to it a bracket 34, which is provided at its inner end with an anti-friction roller 35, that is adapted to ride upon an inclined bar 36 on one end of a cross-bar 37, the opposite end of which is provided with a similar inclined bar 38, upon which rides an anti-friction roller 39, mounted in a bracket 40, fast on the rod 33. The rods 32 and 33 are headed at their inner ends, and are connected together by a cross-bar 41 in a manner to permit said bar to slide upon either one of said rods as the other one is moved outwardly to move either of the switches 22 and 23. The cross-bar 37 is mounted on the inner end of a rock-shaft 42, which extends exteriorly of the box 5 out under the track 2, and preferably terminates at the inner side of the rail, where it is provided with a vertical arm or crank 43, arranged to be struck by the flange of the foremost wheel of the locomotive and turned down in the direction of movement of the train, so as to rock said shaft and partially rotate or tilt the cross-bar 37. The latter is provided on each side of the center line of the rock-shaft 42 with a spiral spring 44, the lower end of which is fastened to the bottom of the box 5, and said cross-rod 37 is also provided near each end with catches 45, which are adapted to engage with the cross-bar 41 on its upper and lower sides when the trip-arm 43 has been turned down by the passing train and the rod 41 fed or moved forward by the action of the inclined arm 36 and the roller 35.

It will be understood that when the trip-arm 43 is moved in the direction of the arrow at Fig. 7 one side of the cross-rod 37 is raised and the other side depressed. The side which is raised carries the inclined arm 36, and its upward movement against the roller 35 operates to force the latter forward toward the track and to carry therewith the sliding rod 32, which in turn operates to throw the switch 22 from the contact 27 to the contact 20, and to pull forward at the same time the cross-rod 41 until the latter shall have been caught above and below by the retaining-catches 45. When the inclined arm 36 is elevated to force the rod 32 forward, it will be understood that the spring 44 nearest the rod 32 is distended and the opposite spring is depressed, also that the inclined arm 38 is moved down out of contact with the roller 39, so as to avoid any forward feed of the rod 33 and any movement of the switch 23, at the same time permitting the opposite end of the cross-bar 41 to slide freely along the rod 33 as the rod 32 is drawn out. Connected to the cross-bar 41, at about its middle, is a sliding rod 46, upon which is secured an armature 47 within the influence of an electro-magnet 48, which by wires 49 and 50 connects with the positive wire 51 of a battery 52, which may be located at any point or points along the line. From the other pole of said battery the negative wire 53 extends, and is connected with the track-instrument by a wire 54, which terminates in a contact 55, which is electrically connected with an arc-shaped plate 56 on the lower end of an arm 57, depending from the rock-shaft 42. The ends of said arc-shaped plate 56 are formed with projections 58 and 59, adapted, respectively, to contact with metallic pins or pieces 60 and 61, according as the rock-shaft is turned in one or the other direction. From the pin 60 a wire 62 extends back to the preceding track-instrument and connects with the electro-magnet 48 and wire 49 thereat. From the block 61 a wire 63 extends forward to the next succeeding track-instrument and connects with the electro-magnet 48 and wire 50 thereat. When the trip-arm has been depressed in the direction of the arrow and the cross-bar drawn forward with the rod 32, the armature 47 is pulled away from its magnet. At the same time by the movement of the rock-shaft 42 a contact is made between the projections 58 and the pin 60, thus completing an electric circuit, which operates upon the track-instru-

ment immediately preceding the one at which the locomotive is at the time the contact is made to restore the switch 22 thereat to its normal position.

By reference to Fig. 2 it will be observed that the current passes from one pole of the battery along the wires 53 and 54, through the arc-shaped plate 56, along the wire 62 to the electro-magnet 48 on the left-hand side of the figure, along the wire 49 to the wire 51, and thence to the other pole of the battery. During the passage of the current through the magnet the armature 47 is attracted, and by its movement the cross-bar 41 is retracted against the frictional grip of the catches, and as soon as released therefrom the spring 44, which was distended, operates to rock the shaft 42 in the opposite direction, and thus raise the trip-arm 43 to its normal vertical position, also to break the contact between the arc-shaped plate 56 and the conducting-wires 62, and to cause the rod 32 to return to its normal position and bring back the switch 22 against the contact 27.

When the switch has been shifted from the contact 27 to that marked 20 by the action of the locomotive in moving in the direction of the arrows at Figs. 2 and 13, the bell of the train immediately following will be rung when the locomotive reaches the block or section of which switch 22 forms the termination, thus warning the engineer that the train ahead is near at hand or has not yet passed out of the next block ahead. As soon as the last-mentioned train reaches the next trip-arm 43 and moves it the switch 22, just described, is, by the means hereinbefore referred to, vibrated back to its first position, thus breaking the circuit of the following locomotive, and causing its bell to cease ringing and give the engineer notice that he may safely proceed onto the next block or section. The bell-circuit, it will be understood, extends from one pole of the battery 17 in the cab by the wire 16, stem 12, and roller 9 to the conductor 7, switch 22, conductor 8, roller 10, stem 13, wire 18, and through the bell to the other pole of the battery. When the switch 22 is returned to the contact 27, it will be seen that the circuit can never be completed, and hence that no alarm can be sounded in the locomotive-cab. The positive pole of the battery in the cab is arranged on the right-hand side always and the negative on the left, so that the system may be operative for signaling the engineers of two trains which are approaching each other when on adjacent blocks, or when on the same block they are in dangerous proximity to each other.

Referring to Fig. 12, it will be observed that two locomotives are drawn in dotted lines as approaching each other. With the poles of the batteries arranged as above described it will be readily seen that the bell 19 in each cab will be rung in such a contingency. The current passes from the positive pole on the right-hand side of the locomotive A down through the described connections to the rod or conductor 7, along the same to the roller 10 of the locomotive B, up through its connections to and through the bell to the negative pole of its battery, and from the positive pole thereof on its right down through the described connections to the rod 8, along the same to the roller 10 of the locomotive A, and up through the described connections to and through the bell 19 to the negative pole of its battery.

It will be understood, of course, that if the approaching trains are on opposite sides of a switch-box 4, as represented at Fig. 12, the switch being in its normal position, as shown, the current will pass from the wire 7 along the metallic rod having the contacts 20 and 21 in said box, and returning will pass along the parts 26, 23, 28, 29, 27, 22, and 26, as shown more particularly at Fig. 1.

The system represented by Figs. 1 to 13, inclusive, is intended particularly for single-track roads, and is therefore duplex in its nature, being capable of operation in either direction of movement of the trains.

I have thus far described the switch portion of the system when trains are supposed to be running in the direction of the arrows at Figs. 1 and 2.

When trains are running in the opposite direction, the switches 23 are operated by the crank-arms 31, sliding rods 33, inclined arm 38, roller 39, cross-bar 37, rock-shaft 42, trip-arm 43, and these switches are returned to their normal position by means of the coiled spring 44 nearest the inclined arm 38, when the cross-bar 41 is released from the catches 45 by the return of the armature 47 under the influence of the magnet 48, which is energized by reason of the contact between the projection 59 and the pin 61, thus establishing a circuit from one pole of the battery 52 along the wire 53, along the wire 54, the wire 63, through the magnet 48, along the wires 50 and 51, to the other pole of the battery, it being understood in this case that the trip-arm 43 and the rock-shaft are vibrated in the opposite direction, and that electrical contact is made on the opposite side of the arc-shaped plate 56.

Referring to Figs. 14 and 15, it will be observed that I have provided a differently-constructed means for operating the switches 22 and 23 and for retaining or locking the rock-shaft 42 when said switches have been moved over to their respective contacts 20 and 21. At the inner end of the rock-shaft is mounted a disk 64, having two shoulders 65 and 66, adapted to be engaged, respectively, by two hooked arms 67 and 68, made integral with pivoted armatures 69 and 70, for which are provided, respectively, electro-magnets 71 and 72. From one coil of the magnet 71 the wire 63 extends out through the box 5 and connects with the pin or contact 61 of the preceding track-instrument, and from the other coil of said magnet extends a wire 49 to the

positive wire 51 of the battery 52. From one coil of the electro-magnet 72 extends a wire 62, which connects with the pin or contact 60 of a similar succeeding track-instrument, and from the other coil of said magnet extends a wire 50, which connects with the main-line positive wire 51 of the battery 52. From the negative wire 53 of the battery 52 a wire 54 extends into the box to the contact 55, with which the arc-shaped plate 56 on the rock-shaft 42 co-operates. On the inner end of the rock-shaft 42 is a vertical arm or projection 73, to which is pivoted loosely at 74 a cross-bar 75, having at one end a slot 76 and at the other end a slot 77. In the slot 76 is inserted a pin 78 on one end of a bell-crank 79, which is pivoted at 80 and whose other end is jointed to the sliding rod 32, which latter is provided with a returning-spring 81 and connected, as before, with the switch 22. In the slot 77 is inserted a pin 82 on one end of a bell-crank 83, pivoted at 84, and jointed at its other end to the sliding rod 33, having a returning-spring 85 and connected to the switch 23. On the rods 32 and 33 are provided stops 86, which abut against the bearings 87 of said rods to limit the return movements of said rods under the influence of their retracting-springs.

In the operation of the apparatus shown at Fig. 14 a train moving in the direction of the arrow thereat will operate to depress the tripping-arm 43 and rock the shaft 42 to cause the arc-shaped plate 56 to contact with the pin 60, also to cause the disk 64 to turn until the hooked arm 68 drops over and engages the shoulder 66 thereon, and also to move the cross-bar 75 toward the rod 33, so as to vibrate the bell-crank 79 and enable it to push the rod 32 outwardly against the tension of its spring, and thus move the point of the switch 22 from the contact 27 to that marked 20.

By reason of the engagement of the hook 68 with the shoulder 66 of the disk 64 the parts above referred to, it will be understood, are all locked or held in their abnormal positions, and that by reason of the shifted position of the switch 22, the engineer of an approaching train would be signaled and notified that the preceding train had not yet departed from the block or section ahead, for in this construction, as in the previous one, the switch 22 is adapted to be restored to its normal position by the train which shifted it when such train reaches a new section or track-instrument, and depresses the next tripping-arm 43. It will be observed that each track-instrument is adapted to move its switch 22 and to assist in returning the switch 22 of the track-instrument behind. When contact is made with the pin 60, the electro-magnet 72 in the preceding track-instrument is energized, the armature 70 attracted by the same, and the hook 68 released from the disk 64. When this occurs, the rock-shaft, the tripping-arm, the disk, the cross-bar 75, the bell-crank 79, the rod 32, and the switch 22 are all returned to their initial positions by the action of the spring 81. During the movement of the cross-bar 75 toward the rod 33 it will be understood that no movement of the bell-crank 83 and rod 33 occurs on account of the relative position of the pin 82 and slot 77. When trains are running in the opposite direction, the tripping-arm 43 will be vibrated in the opposite direction, causing the plate 56 to contact with the arm 61, the hook 67 to engage with the shoulder 65, the bell-crank 83 to be vibrated, the rod 33 to be moved out, and the switch 23 to be shifted from the contact 28 to the contact 21. These parts will of course all be restored to their normal positions when the train reaches the next track-instrument and the contact is made between the parts 56 and 61.

Referring now to Fig. 16, it will be found that the construction of the apparatus is such that it is adapted for use only with trains running in one direction, as on a double-track road, and in the arrangement and operation of the parts it is substantially the same as that half of the instrument shown at Fig. 14 that connects with and actuates switch 22.

Referring now to Fig. 17, it is to be supposed that the box 5 contains mechanism substantially like that shown in the preceding figures.

In this modification of my invention, in lieu of employing two conductors 7 and 8, I employ only one, as 8, and use the rails 2 to perform the functions of the conductor 7. I also dispense with the roller 9 and use an uninsulated wire 16, which is connected to some suitable portion of the locomotive, preferably the frame-work, as at 88, which will enable the current to pass to the rails.

In order to increase the resistance of the rod or conductor 8 should the same be necessary, suitable resistance boxes or coils 89 are introduced, as illustrated.

In a thoroughly practical system I conceive that it will be necessary for the conductor or conductors to be made in the form of rails of large cross-section or diameter in lieu of ordinary wire for the purpose of securing the necessary stability, durability, or permanency of the system. In such a case the conductors would be of such low resistance as that it would be almost impossible to provide suitable or reliable or operable bell-circuits, without employing artificial resistance. In this view it will be understood from what has been said of Fig. 13 that the bell on the locomotive A will be rung to indicate to its engineer that the locomotive B has not yet passed off from the block or section in advance, for switch 22 has not been restored by it to its normal position.

Referring now to Fig. 18, the conductor 7 is dispensed with, as in Fig. 17, and the view

drawn to illustrate how the bells of both locomotives will be rung when two trains are approaching each other on the same track.

In this modification of my invention the arrangement of the poles of the batteries, as described in reference to Figs. 12 and 13, is preserved herein—that is to say, the positive pole is always located at the right-hand side of the locomotive and the negative on the left, no matter which way the train may be moving.

Of course it will be understood that the negative may be always located on the right and the positive on the left, if desired; but in either case it is necessary the batteries of all the locomotives shall be arranged alike in this respect.

Owing to the absence in Fig. 18 of the conductor 7, it is essential to employ in each cab a switch of some sort—as, for instance, a pole-changing switch—so that the roller 10 may connect with either pole of the battery. The pole-changer or switch is required because without it the roller 10 of each locomotive would always be connected to the same pole of the battery, and hence when two trains are approaching each other, as at Fig. 18, like poles would be presented and the bells would fail to ring. In this arrangement or system all trains running in one direction—as, say, north—must have the roller 10 connected with the positive pole of the battery, and all trains running in the opposite direction—or, say, south—must have the roller 10 connected with the negative pole of the battery. The locomotive A is supposed to be running northward and the locomotive B southward. The latter, it will be observed, has the poles of its battery reversely connected from those of the former, the switch hereinbefore referred to being employed at about the locality at which the wires are shown as crossing each other, it being deemed unnecessary herein to show any specific construction of a switch.

The operation of the construction shown at Fig. 18 is substantially the same as that shown at Fig. 12.

Referring to Fig. 19, the box 5 is supposed to contain mechanism substantially like that shown at Fig. 8 or at Fig. 14. From the electro-magnet in this box extend the conductors 90 and 91, the former to a contact 92 in a box 93, arranged at a turn-out or switch 94 of the railroad and the other to the positive pole of a battery 95 in said box. From the negative pole of said battery a wire 96 extends to a contact 97 in said box. Playing between said contacts 92 and 97 is a switch or arm 98 on the inner end of a rock-shaft 99, having at its free outer end a tripping-arm 100, located close to the rail of the siding and adapted to be depressed by the wheel of the locomotive to complete the circuit through the contacts 92 and 97, and switch 98 for the purpose of restoring the switch 22 at the track-instrument box 5 to its normal position against the contact 27, so that the bell of the train following may not be rung when all danger is averted and the section or block ahead is clear. As soon as the train has passed by the arm 100 is returned to its normal position and the switch 98 removed from the contact by means of a spring 101, located within the box 95. The covers of the boxes 4 are preferably provided with supplemental conductors 7^a and 8^a for the wheels 9 and 10. The joints of the several boxes are preferably made water and air tight, and the openings through which the conductors, rods, and other parts enter are packed for the purpose of preventing the admission of water.

It will be understood, of course, that many changes in detailed construction and arrangement may be made without departing from the gist of my several improvements.

What I claim as new, and desire to secure by Letters Patent, is—

1. A railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending continuously throughout the length of the block along the line of the railway, a switch forming a part or continuation of one of said conductors, and means arranged in proximity to one of the rails adapted to be acted upon by one of said locomotives to move said switch to connect with the other of said conductors, so that the locomotive following in the same direction may have its circuit completed through said conductors and switch when said switch is in its abnormal or shifted position, while the bell of the locomotive which effected the movement of said switch, and which has passed to the succeeding section or block, is prevented from being rung by reason of the open condition of one of said conductors in its rear, due to the shifting of said switch, substantially as set forth.

2. A railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending continuously throughout the length of the block along the line of the railway, a switch forming a part or continuation of one of said conductors, means arranged within proximity to one of the rails adapted to be acted upon by one of said locomotives to move said switch to connect it with the other of said conductors and break the continuity of the conductor of which it forms a part, and means adapted also to be acted upon by said locomotive to subsequently disconnect said conductors and restore the switch to its initial position, substantially as set forth.

3. A railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending continuously throughout the length of the block along the line of the railway, a series of switches arranged at suitable intervals to divide the road into blocks or sections, said switches forming portions or continuations of one of said conductors, means arranged in proximity to one of the rails and at each of said switches adapted to be succes-

sively acted upon by a passing locomotive to connect said conductors through said switches, and means adapted also to be acted upon by said locomotive to subsequently and successively disconnect said conductors, substantially as set forth.

4. In a railway signal block system in which the locomotives are provided with open bell-circuits, the combination of suitable conductors extending continuously throughout the block along the line of the railway and on the road-bed thereof, said bell-circuits being in electrical connection with said conductors during the time said locomotives are moving as well as when at a standstill, a switch forming a part or a continuation of one of said conductors, a tripping-arm arranged alongside of one of the rails to be actuated by the passing train, and connections between the tripping-arm and the switch for transmitting the movement of the former to the latter, substantially as set forth.

5. In a railway signal block system in which the locomotives are provided with bell-circuits, the combination of a suitable conductor extending continuously throughout the length of the block along the line of the railway, a switch forming a part or continuation of said conductor and adapted to contact with another parallel conductor, a protecting box or casing for said switch, a tripping-arm arranged alongside of one said rails to be acted upon by the locomotive, and means, substantially as described, connected with said tripping-arm and extending into said box or casing to actuate said switch as the tripping-arm is actuated by the locomotive, substantially as set forth.

6. A railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending lengthwise of the railway, a switch for connecting said conductors, a tripping-arm adapted to be actuated by the train, a rock-shaft connected to said tripping-arm, a sliding rod connected to said switch, and means, substantially as described, for converting the oscillations of said shaft into reciprocatory movements of said rod, substantially as set forth.

7. A railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending lengthwise of the railway, a series of switches arranged at suitable intervals along the road to divide the same into blocks or sections, a series of tripping-arms adapted to be moved by the passing trains, a series of sliding rods connected one to each switch and to each tripping-arm, so that each switch may be moved to connect said conductors as its tripping-arm is actuated, a catch for holding said rod when the switch has been moved to connect the conductors, a spring for returning said rod, an electric circuit extending lengthwise of the road and provided at each switch locality with an electro-magnet and armature connected to the switch-operating rod in a manner to release the catch and permit the spring to restore the switch and the tripping-arm to their normal positions when the train has arrived at the next block and has actuated the succeeding tripping-arm there, substantially as set forth.

8. In a railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending lengthwise of the railway, a series of switches arranged at suitable intervals along the road to divide the same into blocks or sections, a series of tripping-arms adapted to be moved by passing trains, a sliding rod for each switch, a rock-shaft for each tripping-arm, connections between the rod and the shaft, an electric circuit extending lengthwise of the road and provided at each switch locality with an electro-magnet and armature, and a contact movable with some part of the switch-actuating mechanism of each switch for closing the circuit through the magnet at the immediately preceding switch for the purpose of enabling its mechanism to be restored to its normal condition when the train which actuated it originally has passed onto the next or succeeding block or section, substantially as set forth.

9. A railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending lengthwise of the railway, the switches 22 and 23, the independent sliding rods 32 and 33, a rock-shaft having a tripping-arm adapted to be actuated by the passing trains, and connections between the rock-shaft and the rods 32 and 33, whereby either of the latter may be moved forward to operate its switch according to the direction of movement of the tripping-arm, substantially as set forth.

10. In a railway signal system, substantially as described, the combination, with an electric switch, as 22, and means, substantially as described, actuated by the passing trains for moving it from one conductor to another, of a tripping-arm located at a suitable distance from said switch and adapted to be actuated by the passing trains, an electric circuit extending from the switch-actuating mechanism to the distant tripping-arm, and a movable contact adapted to close said circuit when the distant tripping-arm has been actuated for the purpose of energizing the electro-magnet at the switch-operating mechanism, and causing it to start the return of the switch to its normal position, substantially as described.

11. In railway signal block system in which the locomotives are provided with bell-circuits, the combination of a suitable conductor extending along the line of the railway and between the rails thereof, a series of switches forming parts or continuations of said conductor and adapted to contact with another parallel conductor, a series of protecting

boxes or casings for said switches, a series of track-instruments and boxes therefor arranged exteriorly of the tracks and opposite the series of switch-boxes, electric circuits connecting said series of track-instruments, a series of tripping-arms arranged alongside of one of the rails and between the switches and the track-instruments, and means, substantially as described, connected with said tripping-arm and extending between the track-instruments and the switches, substantially as set forth.

12. In a railway signal block system in which the locomotives are provided with bell-circuits, the combination of suitable conductors extending throughout the length of the block along the line of the railway, a series of switches arranged to be moved by one of said locomotives to connect said conductors, and a series of resistance boxes or coils connected to said conductors, substantially as set forth.

13. In a railway signal block system and in combination, locomotives provided with open bell-circuits, including each a battery, suitable conductors extending continuously throughout the length of the block along the line of the railway, and a switch forming a part or continuation of one of said conductors, constructed and arranged to be moved by a passing train through intermediate devices to connect both said conductors and complete the bell-circuit of the following train and leave a broken or open conductor in its rear as it passes onto the next block or section, substantially as set forth.

14. In a railway signal block system and in combination, locomotives provided with open bell-circuits, including each a battery, suitable conductors extending continuously throughout the length of the block along the line of the railway, and a switch forming a part or continuation of one of said conductors at the end of each block or section, constructed and arranged to be moved by a passing train through intermediate devices to connect said conductors when said train passes to or upon a new block or section, and adapted, by means substantially as described, to be restored to its initial position when said train passes from or off of said new block or section, whereby one train may make and break the circuit of a train immediately following, and may also leave a broken or disconnected conductor in its rear to prevent ringing of its own bell when the block in advance is clear or unoccupied, substantially as set forth.

Signed at New York city, in the county of New York and State of New York, this 27th day of September, A. D. 1890.

EDWIN D. GRAFF.

Witnesses:

ABRAHAM M. GRAFF,

JACOB FELBEL.