No. 748,450. PATENTED DEC. 29, 1903.

E. E. WOLF & J. B. WILLIAMS.

BLOCK SIGNAL SYSTEM.

APPLICATION FILED JUNE 20, 1902.

NO MODEL. 4 SHEETS—SHEET 1.

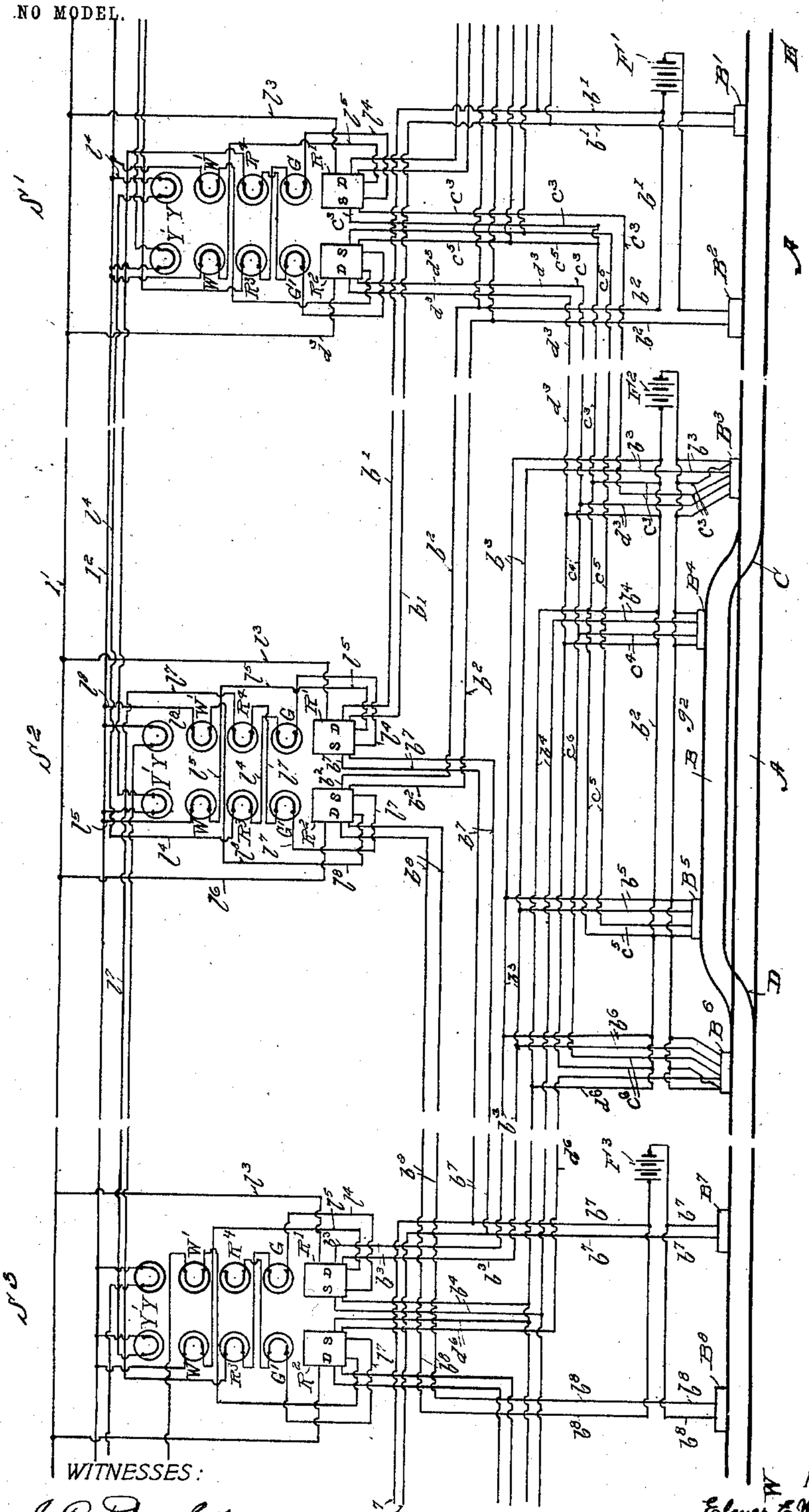

Fig. 1.

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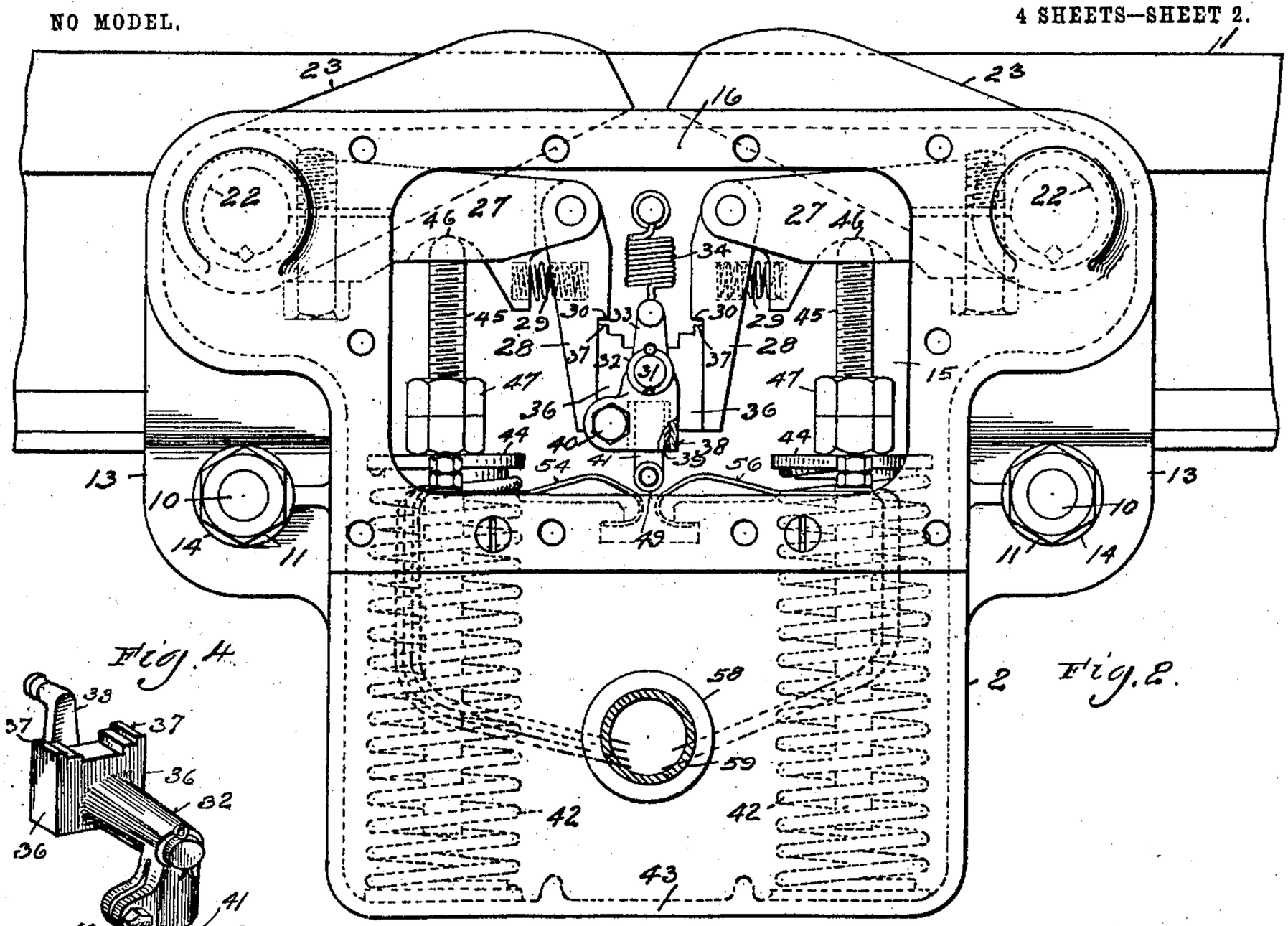
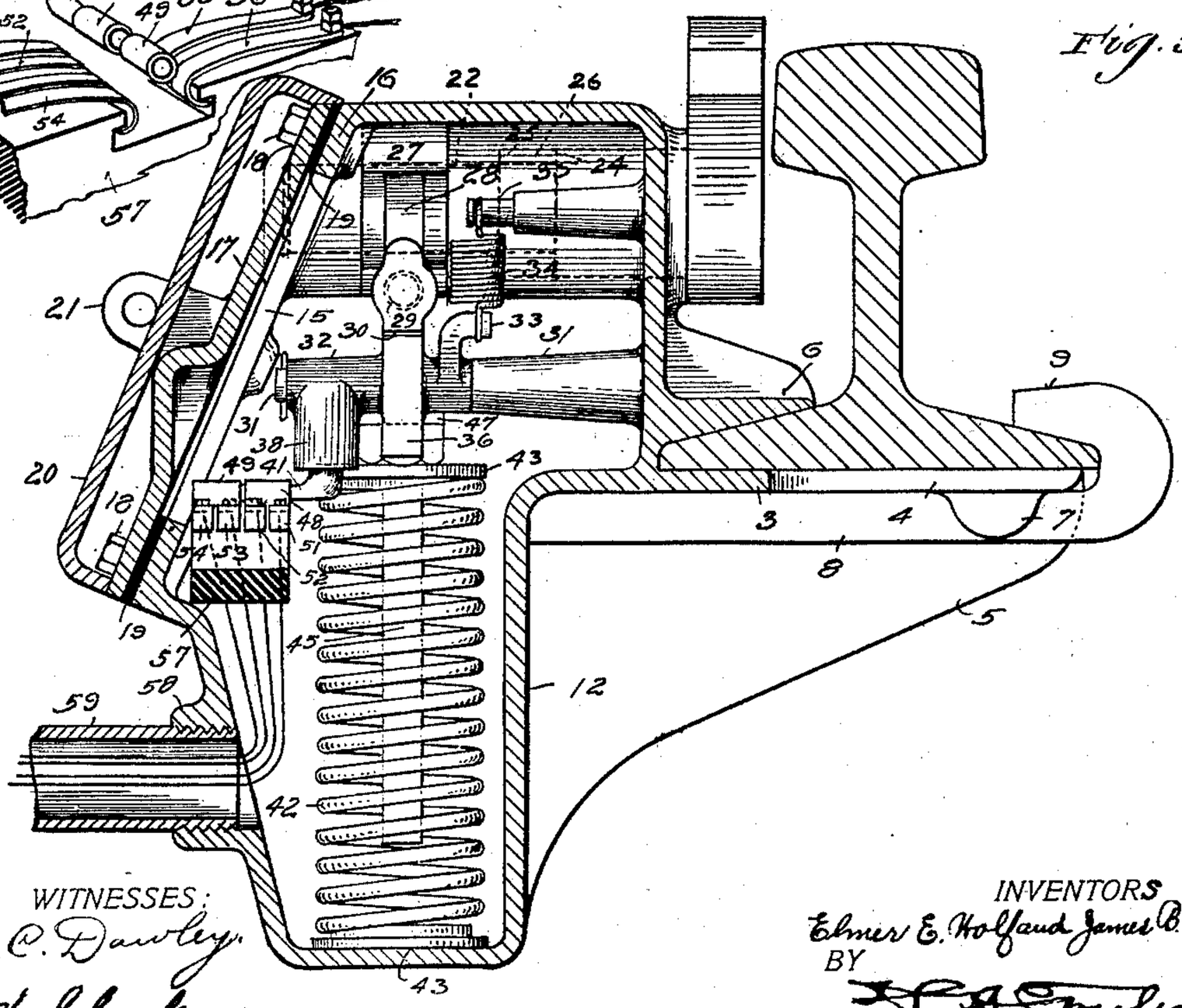


Fig. 2.

Fig. 4.

Fig. 3.



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NO MODEL. 4 SHEETS—SHEET 3.

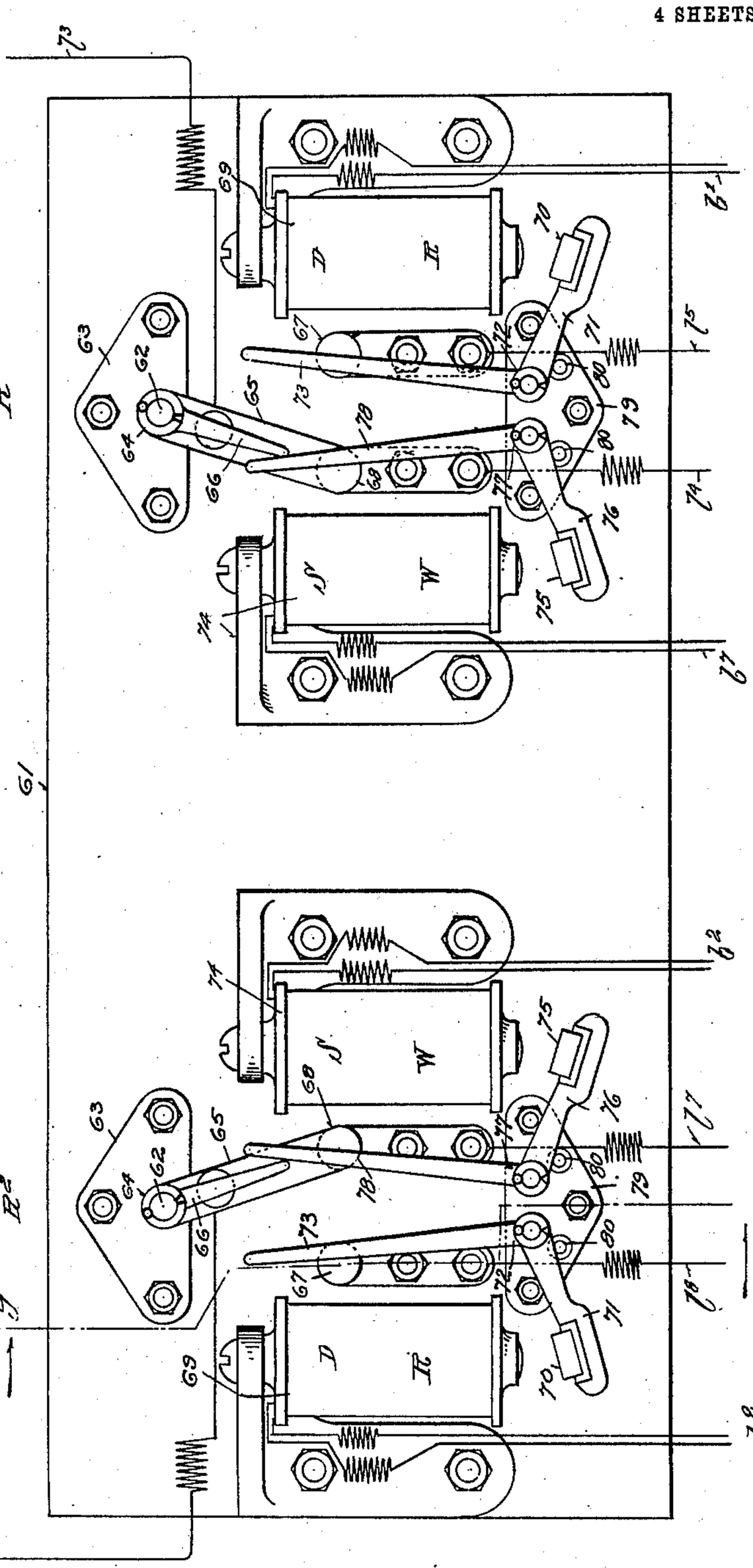

Fig. 5.

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APPLICATION FILED JUNE 20, 1902.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 6.

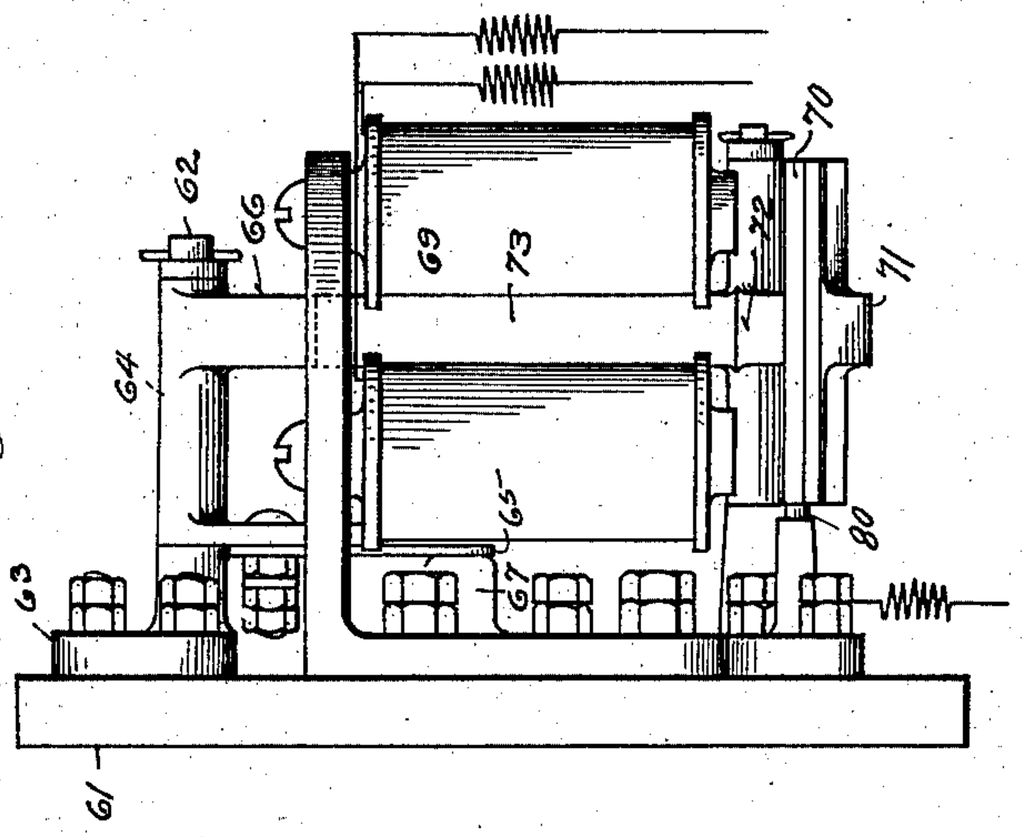
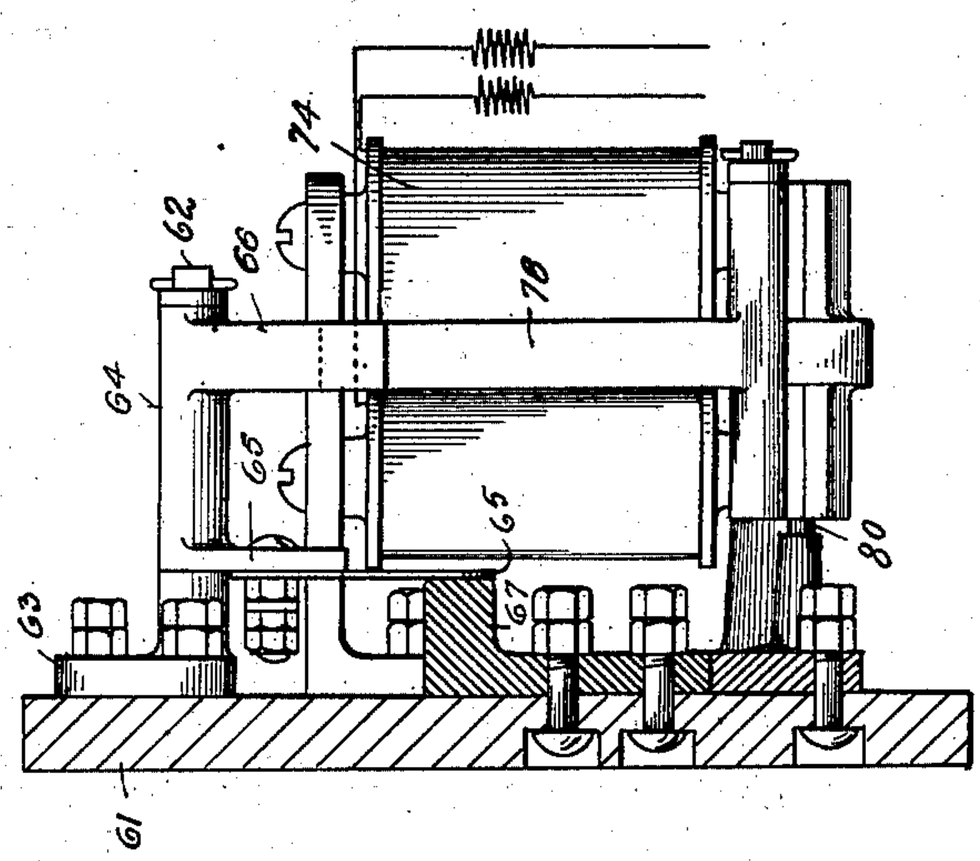


Fig. 7.



WITNESSES:

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No. 748,450. Patented December 29, 1903.

UNITED STATES PATENT OFFICE.

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BLOCK-SIGNAL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 748,450, dated December 29, 1903.

Application filed June 20, 1902. Serial No. 112,415. (No model.)

To all whom it may concern:

Be it known that we, ELMER E. WOLF and JAMES B. WILLIAMS, citizens of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Block-Signal Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to block-signal systems, and has for its object to provide a simple and efficient system of block-signaling based upon the employment of electric circuits controlled by track devices adapted to be automatically operated by the movement of the trains or cars and suitable relays controlled by said track devices and in turn controlling the signal-circuits.

To these ends our invention consists in certain novel features which we will now proceed to describe and will then particularly point out in the claims.

In the accompanying drawings, Figure 1 is a diagrammatic view of a portion of a system embodying our invention. Fig. 2 is front elevation of one of the track devices or track-boxes with the cover removed. Fig. 3 is a sectional view of the same, taken on the line *x x* of Fig. 1 and looking in the direction of the arrows. Fig. 4 is a detail perspective view of a portion of the construction in Figs. 2 and 3. Fig. 5 is an elevation of the signal-controlling relays of one of the signal-stations. Fig. 6 is an end view of the same, and Fig. 7 is a sectional view taken on the line *y y* of Fig. 5 and looking in the direction of the arrows.

In carrying out our invention we employ track devices or track-boxes which are actuated by the trains or cars and which serve to control the electric circuits by means of which the relays are actuated, which relays in turn control the signal-circuits. In Figs. 2, 3, and 4 of the drawings we have shown one of these track-boxes in its most highly developed form, the description of this particular box being equally applicable to the other track-boxes, with the exceptions hereinafter pointed out. Referring to said figures of the drawings, 1 indicates a rail of the railway, and 2 the outer casing or box proper, within which the mechanism, with the exception of the track-levers, is inclosed. This consists of a water-tight casing adapted to be secured to the rail in any suitable manner. The construction we prefer for this purpose is that shown, in which the rear face of the track-box is provided with a horizontal flange 3, extending under the base of the rail and having horizontal extensions 4, also extending under the base of the rail to the farther side thereof, the space between these extensions being cut away. Vertical flanges or ribs 5 serve to strengthen this flange 3 and its extensions 4, and a horizontal flange or extension 6 at the rear of the box fits over the top of the base of the rail in order to more surely engage the parts. Each extension 4 is provided on its inner edge with a downwardly-extending lip or flange 7. The box is held in place by bars or bolts 8, two in number, each fitting between the corresponding rib 5 and lip 7 and having a hooked inner end 9 to engage the base of the rail, its other or outer end 10 being threaded to receive a nut 11. The rear lower wall 12 of the box is extended beyond the body of the box on each side thereof, as shown at 13, each extension 13 being provided with a cylindrical boss 14, through which the threaded end of the corresponding bar 8 extends and beyond which it projects to receive the nut 11, which seats against the end of said boss. The upper part of the body of the box has an opening 15, surrounded by a flat marginal flange 16 to receive a cover 17, secured in position by screw-bolts 18, a packing or gasket 19 being interposed between the cover and flange 16 to make a water-tight joint. The cover 17 is provided with sleeve-like projections 17^a, which extend over and inclose the nuts 10 to prevent access thereto. In order to prevent unauthorized tampering with the mechanism inclosed within the box or removal of the box, we employ an auxiliary cover 20, which incloses the bolts 18 and prevents access thereto, said cover being secured in position by means of an apertured lug 21 on the cover 17, extending through a slot in the cover 20 and adapted to receive a padlock or other locking device. In this way unauthorized access to the nuts 10 or bolts 18 is prevented.

In each end of the track-box there is mounted in a water-tight bearing a shaft 22, carrying at its inner end, which projects beyond the box, a track-lever 23, lying adjacent to the rail, so as to be operated on by the tread or flange of a passing wheel. In order to make the bearing of each shaft 22 water-tight, we prefer to construct each shaft with a reduced end portion, thus forming a shoulder 24. (Indicated in dotted lines in Fig. 3.) The bearing-aperture for said shaft is correspondingly reduced at one end, but for a less distance, thus forming a shoulder 25, between which and the shoulder 24 is located a packing 26 to make a water-tight joint. Each shaft 22 has secured thereon an arm 27, extending into the interior of the upper part of the box and having pivoted to its inner end a dog 28, forced normally outward by a spring 29 and having about midway of its outer face a contact-shoulder 30. Between these dogs there extends forward from the rear wall of the box a fixed shaft or bearing-pin 31, on which is mounted a sleeve 32. This sleeve has an upwardly-extending arm 33, connected by a spring 34 with a pin 35, extending forward from the rear wall of the box. Upon the sleeve 32, on opposite sides thereof, are formed projections 36, having flat outer edges, which rest normally against the flat lower edges of the dogs 28, as shown in Fig. 2, each projection 36 terminating at its upper end in a shoulder 37, lying normally in the path of the shoulder 30 of the corresponding dog. At its forward end the sleeve 32 is provided with a downwardly-extending clamping-socket 38, having an insulating-lining 39 and adapted to grip by means of a clamping-screw 40 the upwardly-extending shank of a horizontal contact-arm 41.

The track-levers 23 and the parts operated thereby are held normally in the position shown by means of coiled springs 42, resting upon the base 43 of the box at its lower ends, their upper ends bearing against washers 44, mounted on threaded thrust-rods 45, having rounded upper ends, which bear in sockets 46 in the lower faces of the arms 27. Nuts 47, mounted on the threaded portions of the thrust-rods 45, serve to adjust the position of the washers 44 thereon, and consequently to correspondingly adjust the thrust of the springs.

In the particular form of construction shown the contact-arm 41 has mounted on it two separated and insulated contact-sleeves 48 and 49, and on one side of said contact-arm there are located two pairs of yielding or spring contact-pieces. The first pair (marked 51 and 52) form the terminals of a circuit which is closed by the sleeve 48 coming into contact with said contact-pieces in the manner hereinafter described. The second pair (marked 53 and 54) are in the path of the sleeve 49 and are adapted to be electrically connected by said sleeve when it contacts with them, as hereinafter set forth, this pair forming the terminals of another circuit. On the opposite side of the contact-arm 41 there is a third pair of contact-terminals 55 and 56, adapted to be similarly connected by either the sleeve 48 or the sleeve 49 when the contact-arm 41 swings in the opposite direction. These contact-pieces are supported on a bar 57, of insulating material, and the lower end of the box is provided in its front or outer face with a threaded opening 58 to receive the correspondingly-threaded end of a pipe or conduit 59, through which the wires are led which are connected to the several terminal contacts on opposite sides of the arm 41. It will be noted that the normal position of the contact-arm 41 is the central position shown, in which there is no electrical connection between any pair of the contact-terminals in the track-box.

It will be seen that if a train or car moves along the rail 1 in one direction, or, say, from right to left in Fig. 2, the first wheel of the train or car will first come into contact with the right-hand lever 23 and will operate its rock-shaft 22, so as to depress the inner end of the arm 27 thereof and cause the shoulder 30 of the right-hand dog 28 to engage with the shoulder 37 of the right-hand projection 36 on the sleeve 32. This will swing the contact-arm over the springs or contact-terminals 51 52 and 53 54, lying to the left of the figure, and will close the circuits of which they are the terminals. Immediately after and almost simultaneously with the depression of the right-hand lever 23 the left-hand lever 23 is also depressed; but such depression has no effect, for the reason that at this time the sleeve 32 is so turned that the lower end of the left-hand projection 36 has forced the lower end of the adjacent left-hand dog 28 outward, while the shoulder 37 at the upper end of said left-hand projection swings inward, so that upon the downward movement of the left-hand dog 28 its shoulder will not engage the corresponding shoulder 37 on the left-hand side, and the downward movement of the dog will have no effect upon the sleeve 32 and its contact-arm. Similarly, a train or gear moving in the opposite direction or from left to right of Fig. 2 will first depress the left-hand lever 23, and thus swing the contact-arm 41 over in such a way as to connect the right-hand terminals 55 and 56. When the left-hand lever is thus first operated, the immediately-following depression of the right-hand lever has no effect upon the sleeve or its contact, for the reasons already explained, one lever being inoperative while the other is depressed. Each lever when first depressed thus exercises an inhibitory action upon the other lever, so that a train or car in passing over the track-box will only affect the electrical connections arranged to be affected by a train or car moving in that direction.

In Figs. 5, 6, and 7 we have shown in detail the construction of the two relays located

at each signal-station. These relays are similar in construction and are designated, respectively, as a whole by the reference characters R′ and R². They are mounted upon a suitable base 61, preferably common to both relays, and each comprises a stud-shaft 62, supported by a bracket 63 and carrying a sleeve 64, provided with a contact-arm 65, which is in electrical connection with one of the main-line wires of the signal-circuit in the manner hereinafter described. The sleeve 64 is also provided with a tappet-arm 66. Cooperating with the contact-arm 65 is a contact-point 67, connected in the manner hereinafter described with the other main-line wire of the signal-circuit through certain signals hereinafter specified. 68 indicates a similar fixed contact-terminal also connected with the other main-line wire of the signal-circuit through certain other signals hereinafter specified. These two contact-points 67 and 68 lie in the path of the contact-arm 65 and are alternately engaged by said contact-arm. An electromagnet 69 in the track-box circuit, hereinafter described, is located on one side of the relay and is provided with an armature 70, pivoted to one arm 71 of an L-shaped lever 72, the other arm 73 of which is adapted to engage the tappet-arm 66. On the other side of the relay is located an electromagnet 74, having an armature 75, secured to an arm 76 of an L-shaped lever 77, the other arm 78 of which is adaptad to engage the tappet-arm 66 from the opposite side to that on which the lever 72 operates. The levers 72 and 77 are pivoted to a bracket 79 on the base 61 and are normally held by gravity in the position shown in Fig. 5, stops 80 being provided to limit their motion. It will be seen that when the electromagnet 69 is energized the arm 73 of the lever 72 will engage the tappet-arm 66 and move the contact-arm 65 onto the contact 68, where it will remain until the lever 74 is energized, whereupon the lever 77 will through its arm 78 engage the tappet-arm 66 and move the contact-arm 65 over onto the contact-arm 67, where it will remain until the electromagnet 69 is again energized.

Having thus described the detailed construction of the track-boxes and relays, we will now proceed to describe the construction of the system illustrated in diagrammatic form in Fig. 1, premising that the particular character of the signals therein shown and the particular colors of the signal-lamps are chosen for purposes of illustration only. In the said figure, A illustrates the main track, and B a siding connected therewith by switches C and D. For purposes of illustration one end of the portion of the track shown is designated as the east end by the letter E and the other as the west end by the letter W. The three signal-stations appertaining to this portion of the track are indicated as a whole by the reference-letters S′ S² S³, it being understood, of course, that the system is capable of development to any number of signal stations and blocks. The several track-boxes of the section of track chosen for illustration are indicated by the reference characters from B′ to B⁸, inclusive. The track-boxes located at each signal-station have no operative connection with the signals of that station except as hereinafter indicated, but control the signals of the two adjacent stations. The track-boxes of each group are preferably provided with a separate battery F′ F² F³ common to all of the boxes of that group, and the boxes nearest the signal adjacent to which the group is placed are preferably located at a distance of about fifteen hundred feet from the signal for the purposes hereinafter specified. The system of signaling shown is one in which incandescent lamps are employed, deriving their lighting-current from a lamp-circuit of which the main-line wires are indicated at l' and l^2. Considering the station S², it will be noted that the signals of this station are controlled by the track-boxes B′ B², located at the station S′, and by the track devices B⁷ and B⁸, located at the station S³. This controlling is exercised so far as trains passing from east to west are concerned by the relay R′ and so far as trains passing from west to east are concerned by the relay R². The contact-arm 65 of the relay R′ is connected by a wire l^3 with the wire l' of the main-line circuit, while the contacts 67 and 68 are respectively connected with branch circuits or wires l^5 and l^4, which are ultimately connected with the other main-line wire l^2. The wire l^4 has connected with it a lamp G, preferably green, and showing on the east side of the signal, or that from which the train to which it relates is approaching, a red lamp, (marked R³,) which is visible on the opposite or west side toward which the train to which it relates is moving and is preferably also carried back to the preceding station S′ and is there provided with a lamp Y of a yellow or other distinctive color. The other wire l^5 also passes to the second main-line wire l^2 and has connected with it a lamp W, preferably white, visible in the direction toward which the train to which it relates moves. Thus when the electromagnet 69, which I term the "danger" magnet, is energized the contact-arm is so moved that the electric current passes through the green and red lamps G and R³ of station S² and through the yellow lamp Y of station S′. When the electromagnet 78 of the relay R′ is energized, the current passes through the white lamp W of station S², and the lamps G and R³ of station S² and the lamp Y of station S′ are extinguished. Similarly the relay R² of station S² has its contact-arm 65 connected with the main lamp-circuit wire l' by a wire l^6. The contact-point 68 of this relay is connected by a wire l^7 with the second main-line wire l^2 of the lamp-circuit, and on this wire l^7 are located a green lamp G′ and red lamp R⁴, the

former visible on the side from which the train to which it relates approaches and the latter on the opposite side of the signal-station S^2, said wire l^7 also, preferably, having on it a light or lamp Y', located on the station S^3 and visible in the direction of approach of the train to which it relates. The contact 67 of the relay R' of the station S^2 is connected by a wire l^8 with the wire l^2, and on this wire is located a white lamp W', visible in the direction of movement of the train to which it relates. The track-box B' is what may be termed a "single-circuit" box, having terminal contact-pieces at one side only, so that a train passing from east to west will close the circuit temporarily, while one passing from west to east will not affect the circuit. This circuit, which is indicated by the reference-numeral b', includes the danger-magnet 69 of the relay R' of the station S^2. The track-box B^2 is similarly a single-circuit box, but reversely arranged, so as to be affected only by trains moving from west to east, and its circuit (indicated by the reference-letter b^2) includes the safety-magnet 74 of the relay R^2 of the station S^2. Similarly, the track-box B^7 is a single-circuit box affected only by trains moving from east to west and connected by a circuit b^7 with the saftey-magnet 74 of the relay R' of the signal-station S^2, while the track-box B^8 is a single-circuit box affected only by trains moving from west to east and connected by a circuit b^8 with the danger-magnet 69 of the relay R^2 of the signal-station S^2. Thus a train passing from east to west in passing over the box B' will momentarily close the circuit b', energize the danger-magnet 69 of the relay R' of the station S^2, and thereby move the contact-arm 65 onto the contact 68, thus closing the circuit l^3 l^4 and lighting the lamps G and R^3 at station S^2 and the lamp Y at station S', at the same time extinguishing the lamp W at station S^2. The closing of the circuit b' is momentary; but the signal-circuit l^3 l^4 remains open until the other magnet of the relay R' is energized. The train proceeding westward passes over the signal-box B^2, which is not affected by it, being only affected by east-bound trains. The intervening boxes have no effect upon the signal-station S^2, and the west-bound train passes over the box B^7, the circuit b^7 of which is momentarily closed, thereby energizing the safety-magnet 74 of the relay R' of station S^2 and moving the contact-arm 65 onto the contact 67 of said relay. This breaks the circuits l^3 l^4, extinguishing the lamps G and R^3 at the station S^2 and the lamp Y' at S' and at the same time closes the circuit l^3 l^5 and lights the lamp W at station S^2. The train proceeding on its way passes over the box B^8, which is not affected thereby. In the same way trains passing from west to east will by means of the relay R^2 and boxes B^8 and B^2 first light the lamps G' and R^4 of station S^2 and the lamp Y' of station S^3 and will subsequently extinguish these lamps and light the lamp W' after having reached the station S'. Thus a train passing a given station will at the station ahead of it set a distinctive signal visible from each side of the station ahead of it and also a distinctive signal visible from the direction in which it is moving at the station which it passes, while it will set the distinctive safety-signal and extinguish the danger-signals at the station at which it has last passed. The setting of the boxes at a suitable distance—say fifteen hundred feet—from the station adjacent to which they are located enables the engineer to observe any change in signals at that station due to the simultaneous arrival of a train at the controlling-boxes on the other side of the station which lie in the direction in which he is moving. This feature, while advantageous, is not essential, and consequently the boxes B' B^2, as well as the boxes B^7 B^8, might be consolidated in a single two-circuit box having a pair of terminals on each side of the swinging contact-arm thereof. Each signal-box B' B^2 B^7 B^8 has a circuit extending back to the safety-magnet of the corresponding relay of the station back of that at which the box is located, so that at the same time that the box sets the signals of its direction to "danger" at the station ahead it sets them to "safety" at the station back of the one the train is passing.

At the station S^2, I have shown a siding B, located for the passing of trains, connected at each end with the main-line track A by switches C and D. Track-boxes B^3 and B^4 are located, respectively, on the main line and siding on opposite sides of the switch C, and similar track-boxes B^5 and B^6 are located, respectively, on the siding and main line on opposite sides of the switch D. The boxes B^3 and B^6 are preferably located a sufficient distance from the switch to which they relate to permit a train to be backed from the siding onto the main line without affecting the box. The boxes B^3 and B^6 are three-circuit boxes, and, referring first to the box B^3, it will be noted that one of its circuits, b^3, is connected with the danger-magnet 69 of the relay R' of the station S^3. The second circuit, c^3, of the box B^3 is connected with the safety-magnet 74 of the relay R' of the station S'. The third circuit, d^3, of the box B^3 is connected with the danger-magnet 69 of the relay R^2 of the station S'. The circuits b^3 and c^3 of the box B^3 are closed momentarily by a train passing from east to west, while the circuit d^3 is closed momentarily by a train passing from west to east. The box B^4 is a two-circuit box, of which the circuit b^4, closed by a train passing from east to west, is connected with the safety-magnet 74 of the relay R' of the station S^3, while the circuit c^4, closed by a train passing from west to east, is connected with the danger-magnet 69 of the relay R^2 of the station S'. At the other end of the siding the arrangement is the same, but reverse. The box B^6 is a three-circuit

box, of which the circuits d^6 and c^6 are simultaneously closed by a train passing from west to east and are respectively connected with the safety-magnet of the relay R^2 of the station S^3 and with the danger-magnet 69 of the relay R^2 of the station S'. The third circuit b^6 of the box B^6 is connected with the danger-magnet 69 of the relay R' of the station S^3, and this circuit is closed by west-bound trains only. The box B^5 is a two-circuit box, of which the circuit c^5, closed by east-bound trains only, is connected with the safety-magnet 74 of the relay R^2 of the station S', while the circuit b^5, closed only by west-bound trains, is connected with the danger-magnet 69 of the relay R' of the station S^3. From this construction it will be seen that a train moving from east to west in passing over box B^3 will set the west-bound signals at S^3 to "danger" and those at S' to "safety," at the same time lighting the west-bound yellow danger-signal Y at the station S^2. If this train does not take the siding, it does not affect the boxes B^4 and B^5, and in passing over B^6 it has no effect on the west-bound danger-signals at S^3, which are already set to "danger." If this west-bound train passes upon the siding B by means of the switch C, in passing over the track-box B^4 it will set the west-bound signals at S^3 to "safety." In passing off the siding B by the switch D the west-bound train will by closing the circuit b^5 of the track-boxes B^5 again set the west-bound signals at S^3 to "danger," and these signals will not be affected by the passage of said train over the box B^6, since the circuits c^6 and d^6 are not affected by west-bound trains, while the circuit b^6 when closed does not affect the signals of the signal-station S^3, which are already set for "danger." Similarly east-bound trains passing over the track-box B^6 will set the east-bound signals at S^3 to "safety" and those at S' to "danger," and if such east-bound train takes the siding B by means of the switch D it will in passing over the box B^5 set the east-bound signals at S' to "safety," while in passing off of the siding by the switch C it will through the box B^4 again set the east-bound signals at S' to "danger."

It will be noted that the circuits b^3 and c^3 of the track-box B^3 are similar to the ordinary circuits of the corresponding track-boxes B' and B^7 and serve to set the danger-signal at the station S^3 ahead and the safety-signal at the station S' behind for trains westbound. The third circuit d^3 of the track-box B^3 is only affected by east-bound trains and is connected to the danger-magnet of the relay R^2, which controls the east-bound signals at the station S'. The purpose of this construction is as follows: Assuming that the station S^2 is to be used in such a way that a west-bound train after taking the siding B to permit an east-bound train to pass is compelled to back off of the siding by means of the switch C before starting westward again, it will be seen that the west-bound train does not pass over the box B^5 and cannot, therefore, utilize circuit b^5 to set the west-bound signals at station S^3 to "danger;" but when said west-bound train passes over the box B^6 it will through the closing of the circuit b^6 set the west-bound signals at S^3 to "danger," and thus protect the track in front of it. This condition of affairs frequently arises—as, for instance, where a slow west-bound train is overtaken by a fast west-bound train at station S^2 and both west-bound trains are to be passed by an east-bound train. In that case the slow west-bound train occupies the west end of the siding B, so that after the east-bound train has passed the fast west-bound train must back off the siding B in order to pass the slow west-bound train. This it may readily do, using the circuit b^6 of the box B^6 to set the west-bound signal at S^3 ahead of it, while if it were not for this arrangement it could not protect the block in front of it, since it cannot move westward over box B^5, owing to the slow west-bound train between it and said box. Of course the same reason exists for the third circuit d^3 at the box B^3.

In the case of a stub-switch a track-box may be employed having a circuit-closing lever for the entering train connected by circuits to the safety-magnets of both of the adjacent signal-stations, and a circuit-closing lever for the train moving out connected to the danger-magnets of the same stations.

We do not wish to be understood as limiting ourselves to the precise details hereinbefore set forth, and shown in the accompanying drawings. For instance, the signal-circuits may be provided with signals other than the lamps hereinbefore referred to, and their arrangement may be varied as circumstances may require. Thus the lights or signals Y and Y', employed to protect the rear of the train, are adjunctive devices, which, while deemed desirable, are not necessary parts of our invention and may be dispensed with. The invention, therefore, in its broadest forms does not include the signals Y and Y', and it is in this sense that those claims are to be construed which omit reference to these auxiliary signals. These and other modifications which will readily suggest themselves to those familiar with the art may obviously be made without departing from the principle of our invention.

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

1. In an automatic block-signal system, the combination, with signal-stations each having separate danger and safety circuits and separate visible signals for trains moving in each direction, of two relays at each station, one for each separate set of danger and safety circuits, each relay comprising a switch by which either the safety or danger circuit related thereto may be energized, and track devices at each station, comprising circuit-clos-

ing devices and circuits connected with the corresponding relays of the two other and adjacent stations and adapted to be operated only by trains moving in the direction to which the signals controlled by said relays relate, substantially as described.

2. In an automatic block-signal system, the combination, with signal-stations each having danger and safety circuits and signals for trains moving in each direction, of relays at each station for each set of signal-circuits, and track devices at each station, comprising circuit-closing devices and circuits connected with the corresponding relays of the two other and adjacent stations and adapted to be operated only by trains moving in the direction to which the signals controlled by said relays relate, each of said danger-circuits comprising a danger-signal located at the station where its operating circuit-closing device is located, substantially as described.

3. An automatic block-signal system comprising a lighting-circuit, signal-stations having danger and safety branch circuits and signal-lamps therein, one set for each direction of train movement, and separate relays for each set at each station, each relay comprising a switch by which either the safety or danger branch circuit may be connected with the lighting-circuit, and track devices at each station comprising circuit-closing devices and circuits connected with the corresponding relays of the two other and adjacent circuits and adapted to be operated only by trains moving in the direction to which the signals controlled by said relays relate, substantially as described.

4. An automatic block-signal system comprising a lighting-circuit, signal-stations having danger and safety branch circuits and signal-lamps therein, one set for each direction of train movement, and separate relays for each set at each station, each relay comprising a switch by which either the safety or danger branch circuit may be connected with the lighting-circuit, and track devices comprising circuit-closing devices at each station and circuits connected with the corresponding relays of the two other and adjacent circuits and adapted to be operated only by trains moving in the direction to which the signals controlled by said relays relate, each of said danger-circuits comprising a danger-signal located at the station where its operating circuit-closing device is located, substantially as described.

5. In an automatic block-signal system, a main line and siding connected therewith by switches at each end, a block-signal station on each side of said siding, each station having danger and safety circuits and signals for trains moving in each direction, separate relays at each station for each set of signals, track devices comprising circuit-closing devices and circuits connected with the corresponding relays of the two signal-stations and adapted to be operated only by trains moving in the direction to which the signals controlled by said relays relate, said track devices being located on the main line beyond each end of the siding, and other track devices located on the siding near the ends thereof and comprising circuit-closing devices and circuits connected with the respective relays of said signal-stations, so as to set one of said signals to safety when a train takes the siding, and to danger when it leaves the same, substantially as described.

6. In a block-signal system, the combination, with safety and danger signal circuits and signals, and relays controlling the same, of a track-box comprising parallel rock-shafts having adjacent track-levers adapted to be successively depressed by a passing train, an oscillating or rocking part provided with a contact-arm, contacts located laterally of said oscillating part and adapted to be electrically connected thereby, arms connected with said track-levers and provided with dogs to engage said oscillating part when the corresponding track-lever is depressed, one of said dogs being operative when the other dog is in operative engagement with said oscillating part, and means for returning said track-levers, arms and dogs to their normal position when released, substantially as described.

7. In an automatic block-signal system, a relay comprising an oscillating shaft or sleeve provided with a contact-arm and a tappet-arm, said oscillating part being connected with the signal-circuit, two fixed contacts arranged to be engaged by said contact-arm and connected respectively with the danger and safety branches of the signal-circuit, electromagnets arranged on opposite sides of said contacts and connected with the respective track devices for setting the danger and safety signals, and levers provided with armatures for the electromagnets at one end and having their other ends adapted to engage the tappet-arm when the respective magnets are energized, substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

ELMER E. WOLF.
JAMES B. WILLIAMS.

Witnesses:
E. O. HAGAN,
IRVINE MILLER.