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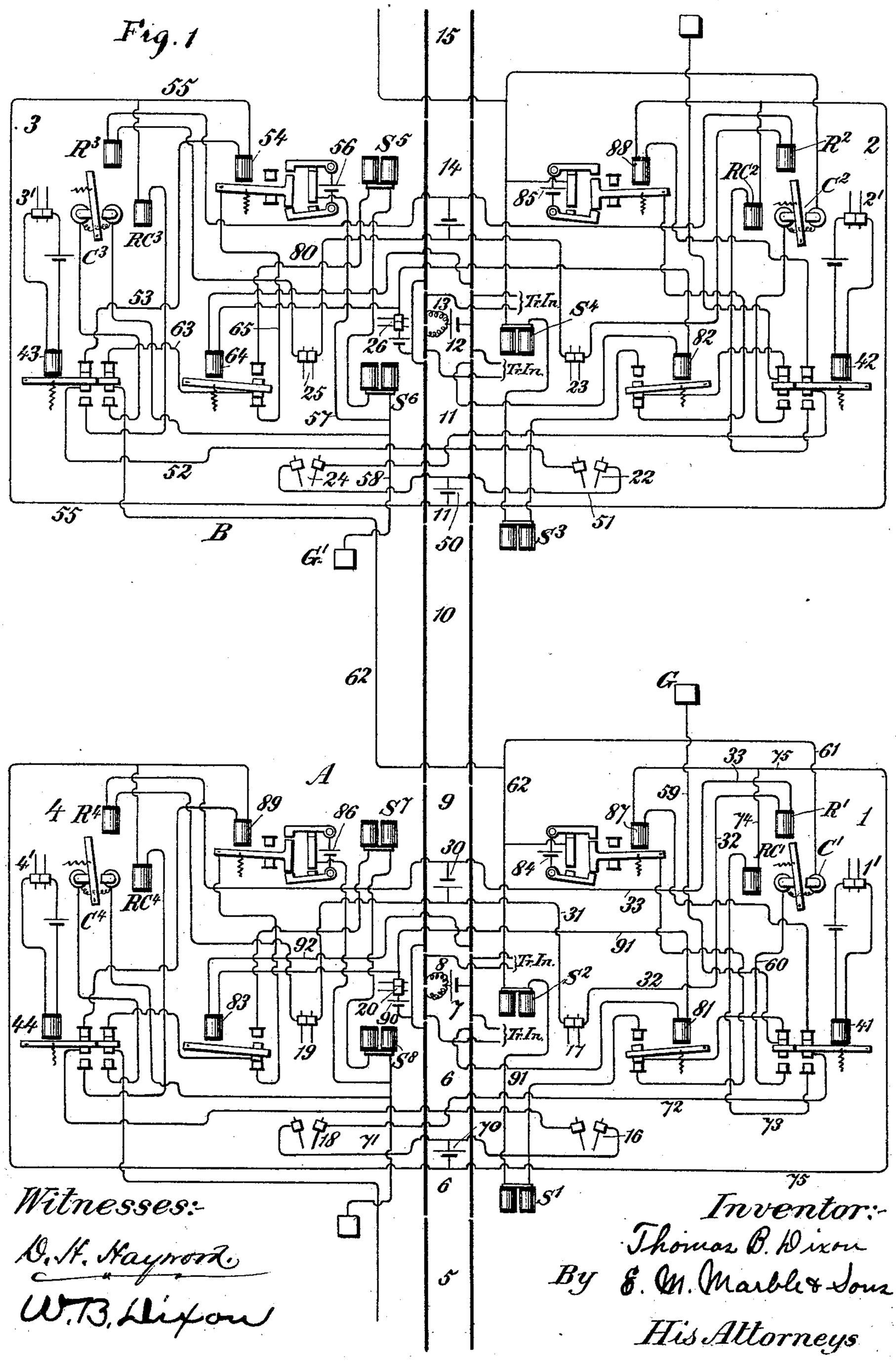
T. B. DIXON.

ELECTRICAL RAILWAY SIGNALING SYSTEM.

No. 543,596. Patented July 30, 1895.

Fig. 1



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(No Model.) 6 Sheets—Sheet 2.

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ELECTRICAL RAILWAY SIGNALING SYSTEM.

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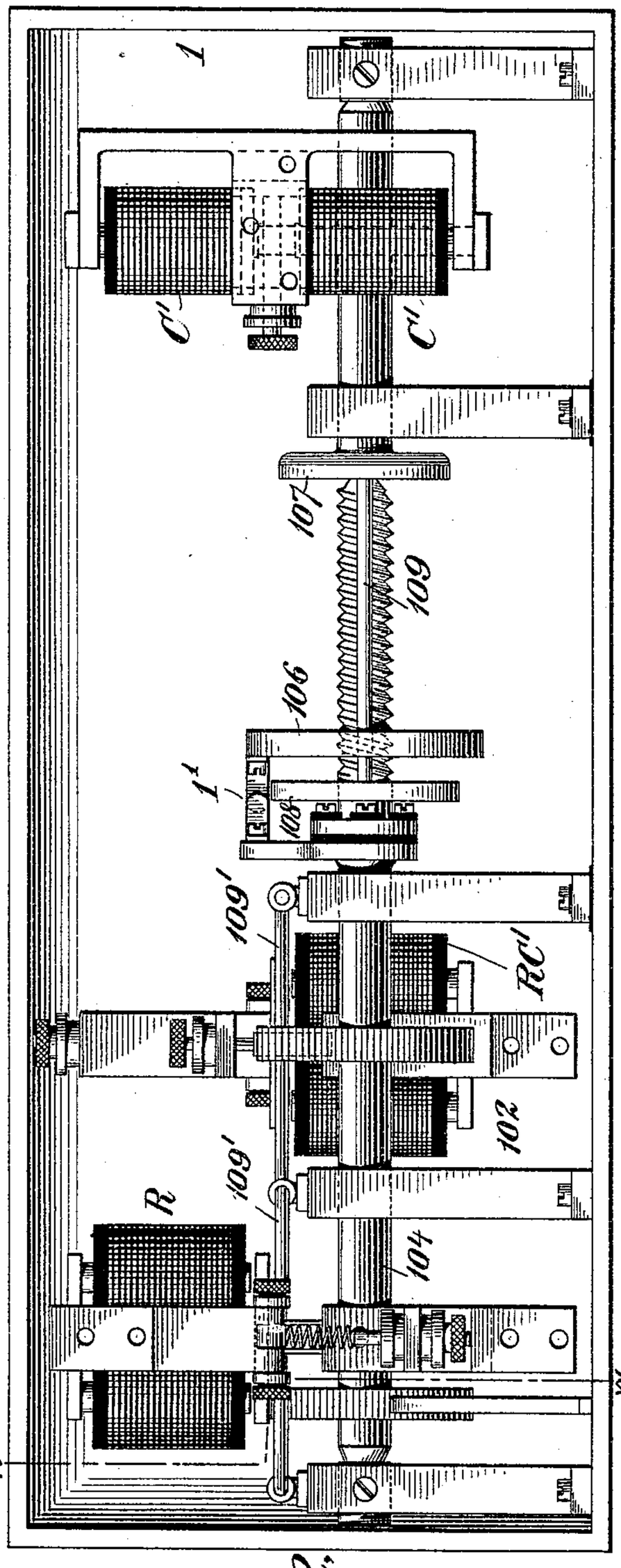

Fig. 2.

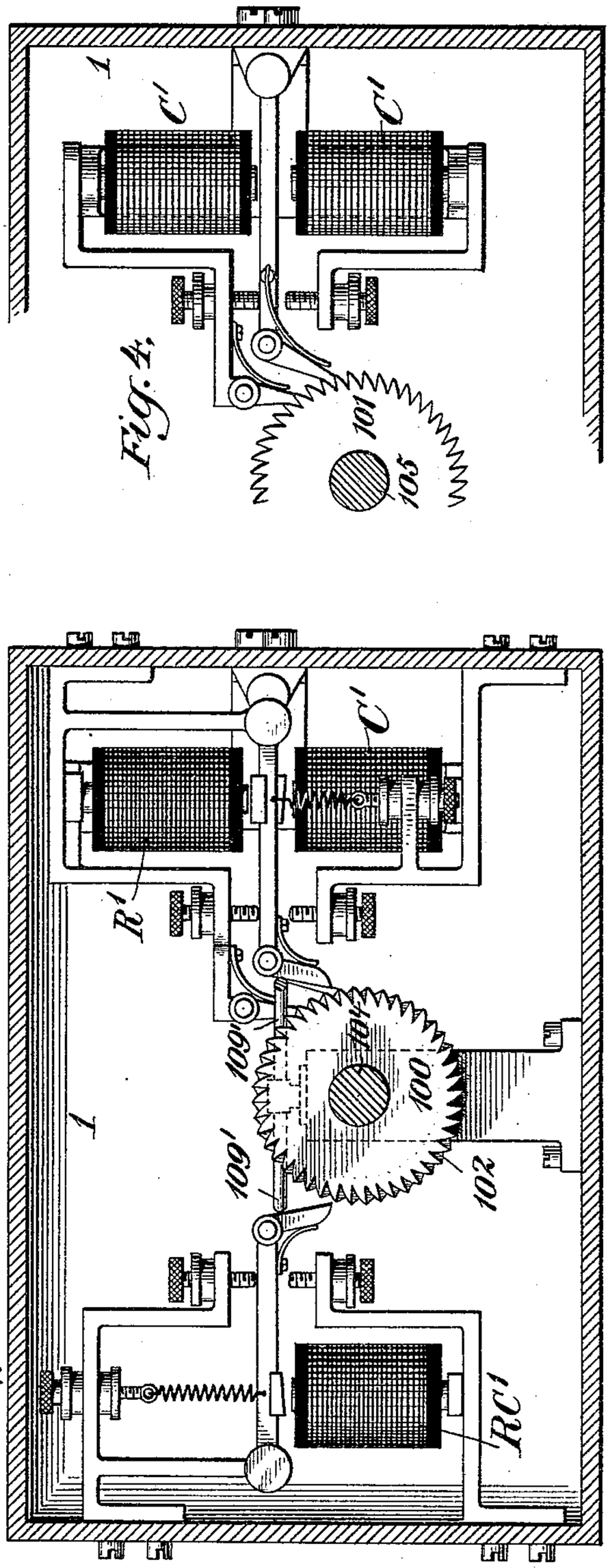

Fig. 3.

Fig. 4.

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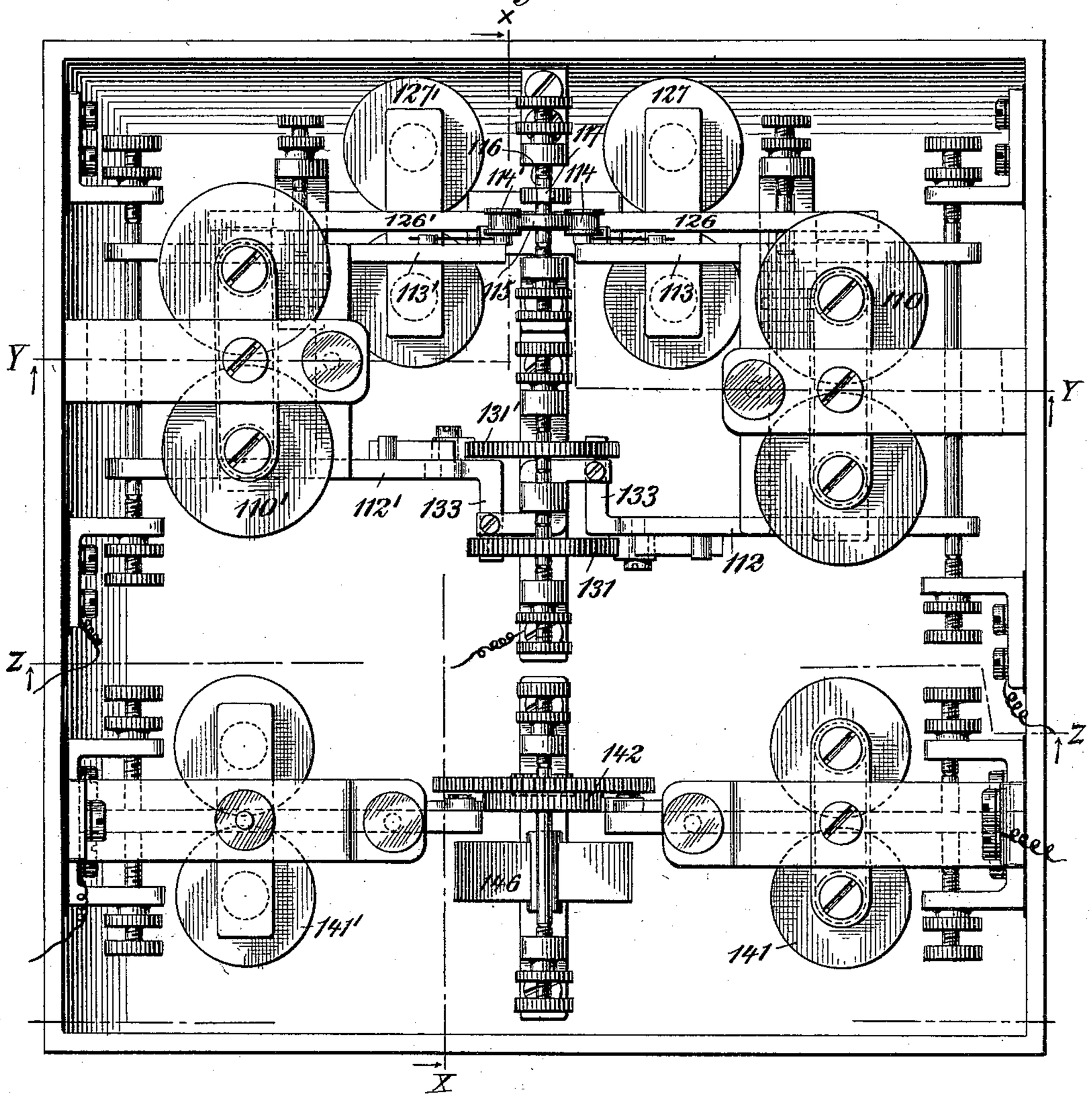
Fig. 5.



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ELECTRICAL RAILWAY SIGNALING SYSTEM.

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Fig. 6.

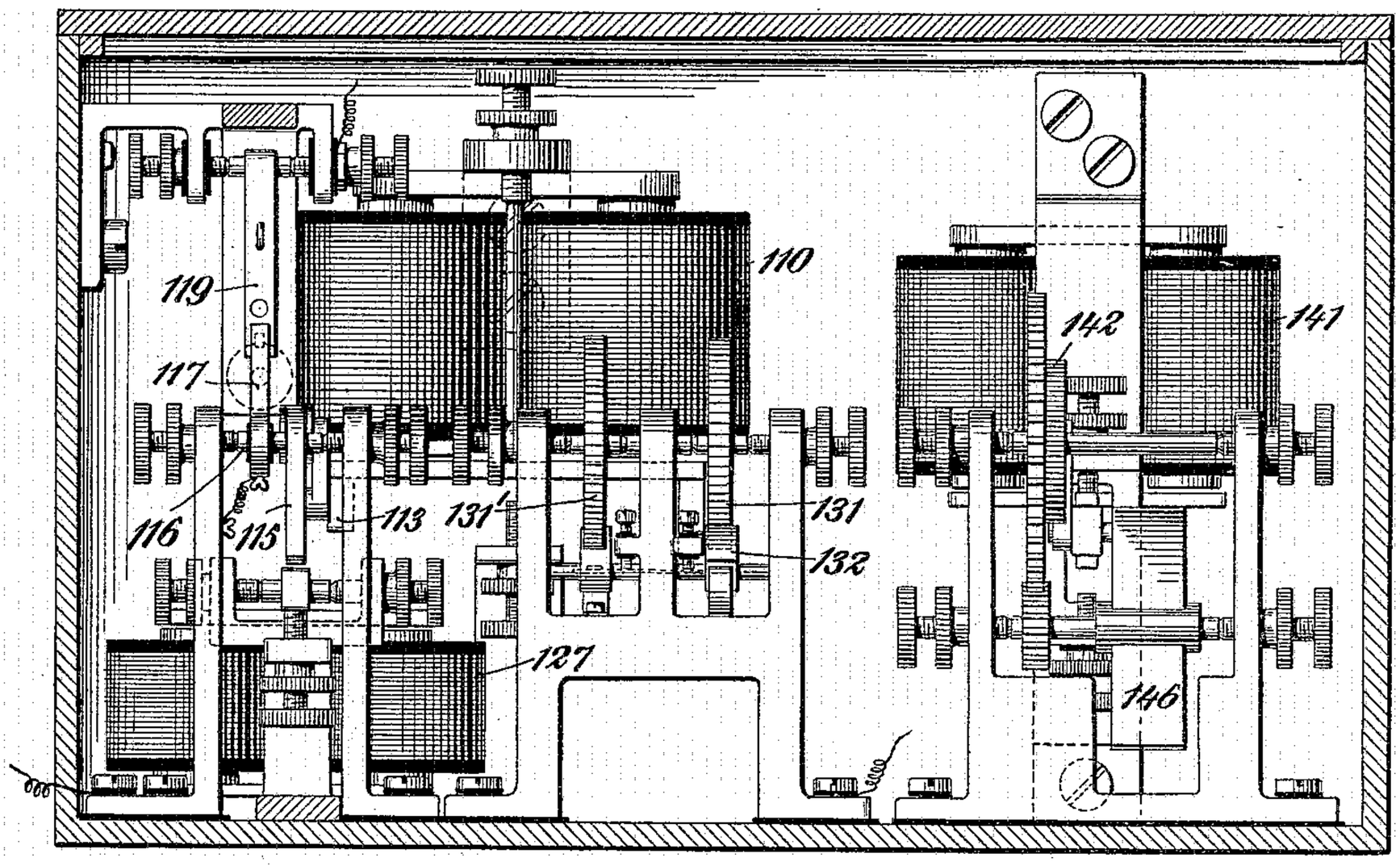
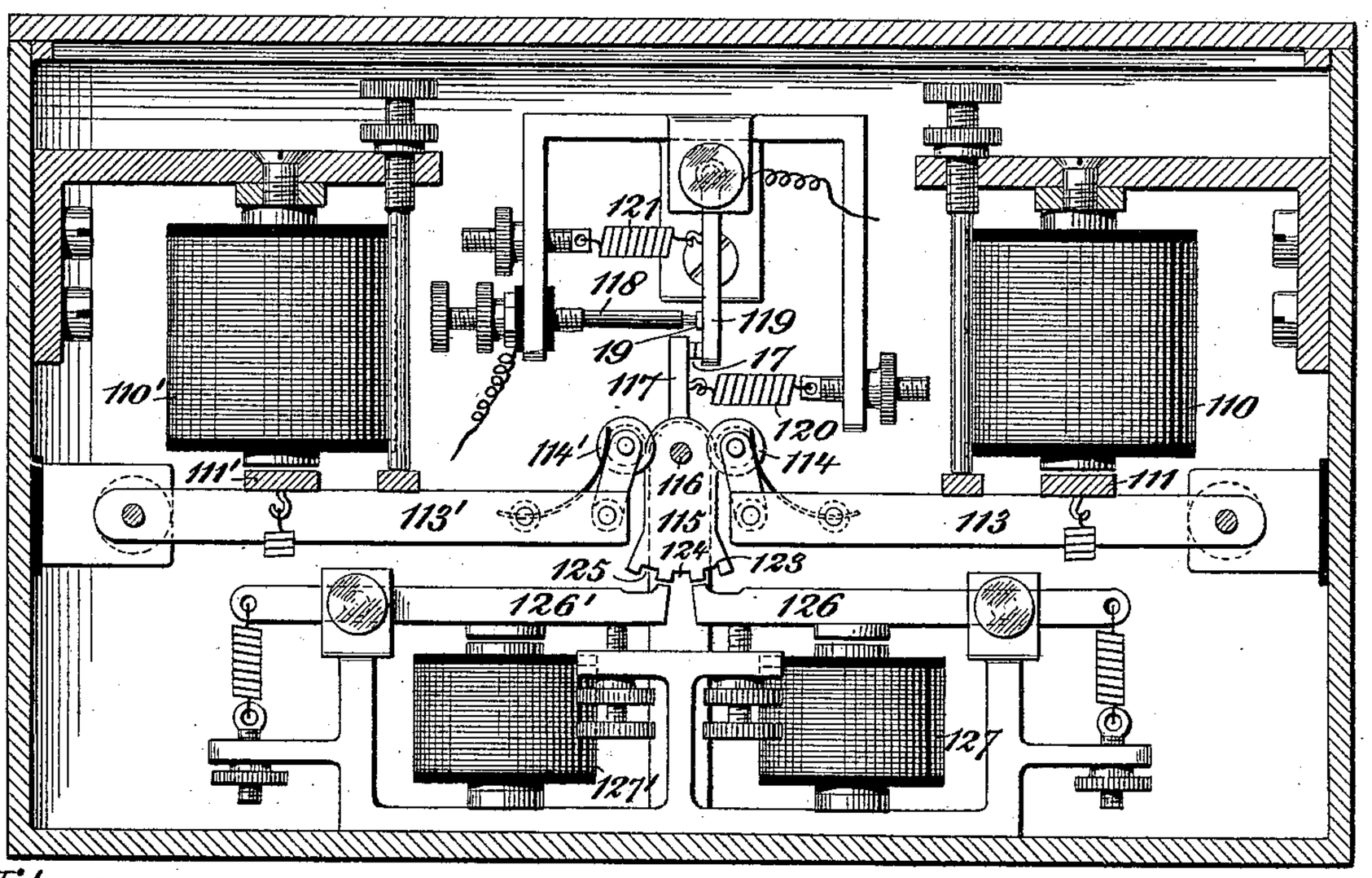


Fig. 7.



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ELECTRICAL RAILWAY SIGNALING SYSTEM.

No. 543,596. Patented July 30, 1895.

Fig. 8.

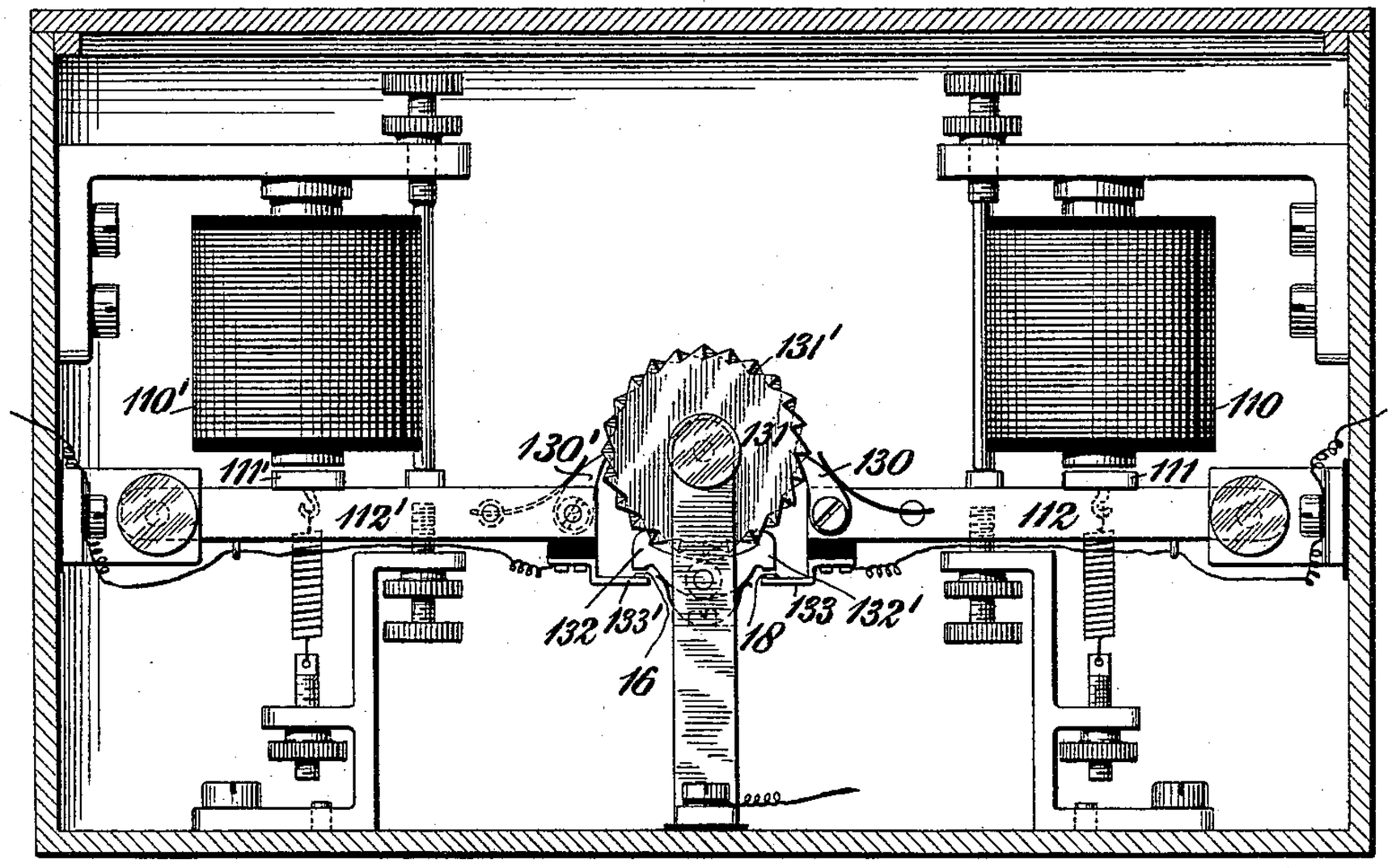
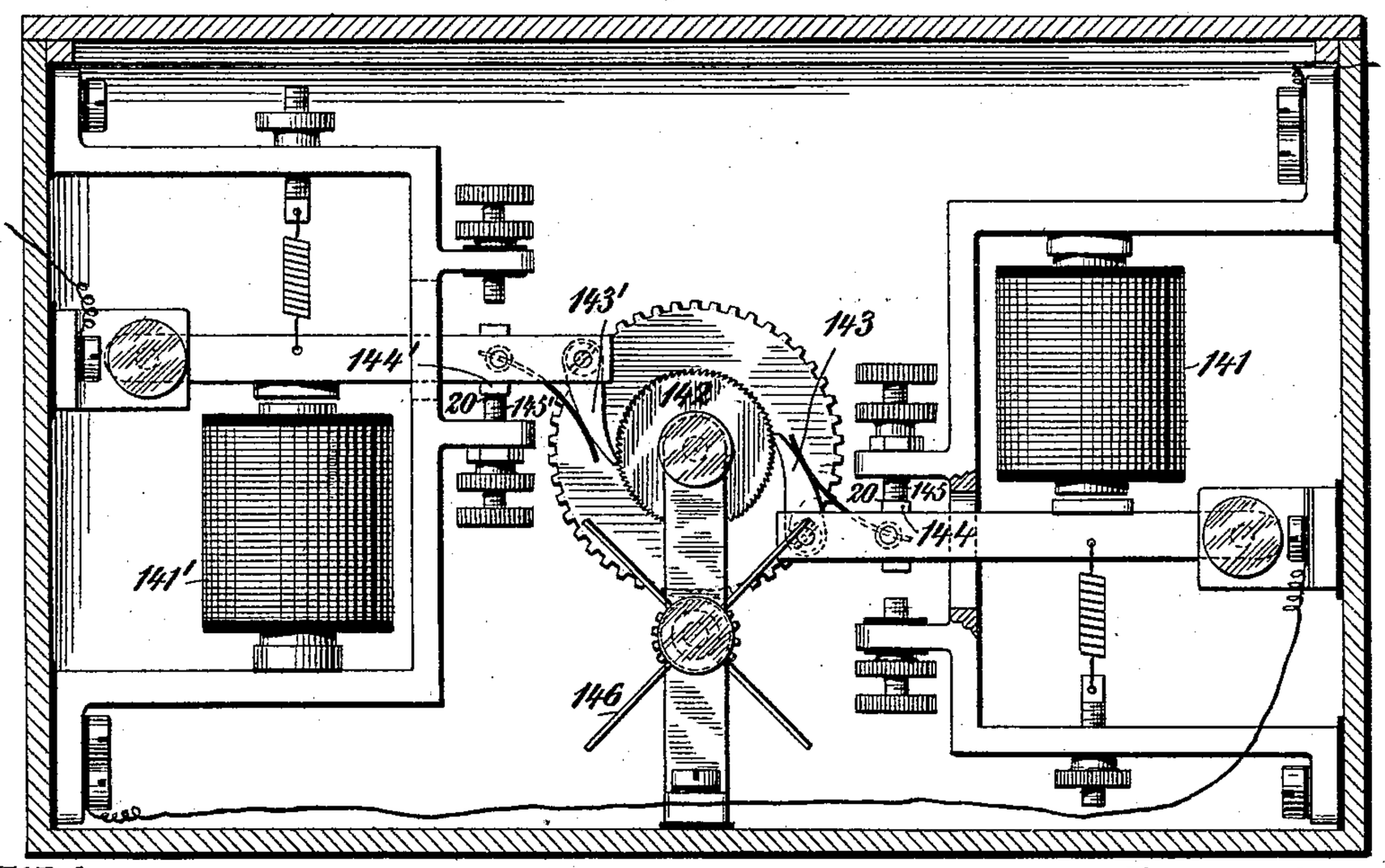


Fig. 9.



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(No Model.) 6 Sheets—Sheet 6.

T. B. DIXON.

ELECTRICAL RAILWAY SIGNALING SYSTEM.

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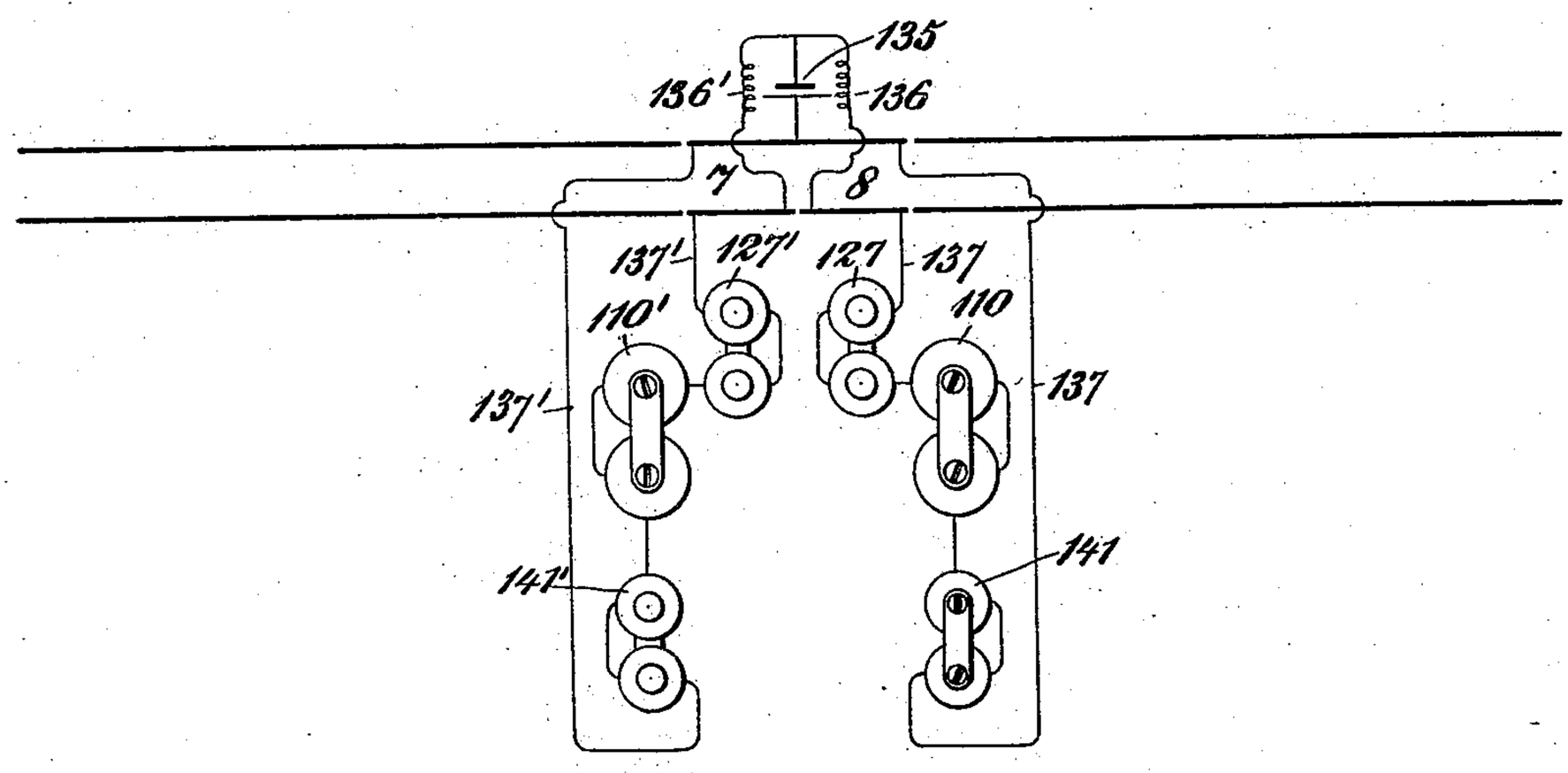
Fig. 10.



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UNITED STATES PATENT OFFICE.

THOMAS B. DIXON, OF HENDERSON, KENTUCKY.

ELECTRICAL RAILWAY SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 543,596, dated July 30, 1895.

Application filed August 20, 1894. Serial No. 520,810. (No model.)

To all whom it may concern:

Be it known that I, THOMAS B. DIXON, a citizen of the United States, residing at Henderson, in the county of Henderson and State of Kentucky, have invented certain new and useful Improvements in Electrical Railway Signaling Systems; and I 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.

My invention relates to electrical railway signaling systems and particularly to block signaling systems for single-track railways or for multiple-track railways, over the tracks of which traffic ordinarily takes place in both directions; and my invention consists in the novel combinations of circuits, signals, and instruments hereinafter described.

The invention herein described is a modification of the signaling system described in an application for Letters Patent filed by me on October 5, 1893, Serial No. 487,209, and provides for controlling the signal-circuits by means of registers such as that described in my application for Letters Patent, filed February 14, 1894, Serial No. 500,169, which register the number of wheels of a train entering a block and check off or cancel the number of wheels of that train when it passes out of the block, holding to "danger" the signals until all the wheels which passed into the block have passed out of the block. I thus avoid any necessity of using track-circuits extending through the block for holding the signals at "danger" so long as cars remain in the block, the use of track-circuits being objectionable because it is difficult to insulate the rails sufficiently and to keep the insulation good, and because expensive bonding of the rails is usually required. By the system of signals herein described I obtain as perfect protection for trains as could be obtained by the use of track-circuits, while I use but few and short track-circuits, and these are placed at signal-stations, where the track insulation may be kept in good condition without difficulty.

The objects of my invention are, first, to provide a system of electrically-operated signals which shall be equally effective in maintaining a space interval between trains on a single track, whether those trains move in the same or in opposite directions; second, to provide circuits for so operating the signals that the safety factor may be as high as possible; third, to arrange suitable registering-instruments to so control the signal-circuits that the signals of a block may not be set to "safety" so long as a car is within that block; fourth, to dispense with track-circuits extending through the block; fifth, to make the number and length of the circuits and conductors as small as possible; sixth, to make the operation of the circuits simple and to guard against liability to derangement of the circuits; seventh, to arrange the signal-circuits to be controlled by hand when desired, and eighth, to render the system economical in the use of battery-power. These objects are attained in the invention herein described and illustrated in the drawings which accompany and form a part of this application, in which the same reference letters and numerals indicate the same or corresponding parts, and in which—

Figure 1 shows my registering system of signals applied to one block of a single-track railway, the circuits being arranged to provide for travel in both directions over this track. Figs. 2, 3, and 4 illustrate the register used in connection with the circuits of this system for automatically registering wheels of a train when they pass into the block and for canceling those wheels when they pass out of the block, this register, as above stated, forming the subject-matter of a separate application for Letters Patent. Fig. 2 is a side elevation of the register. Fig. 3 is a transverse section taken on the irregular section line W W of Fig. 2; and Fig. 4 is a detail elevation of the canceling mechanism of the register, which is operated by a magnet with polarized armature after the manner of the ordinary polarized relay. Figs. 5, 6, 7, 8, 9, and 10 illustrate a track-instrument of my invention which is adapted for operating the circuits and registers of this system and which forms the subject-matter of an application for Letters Patent filed August 20, 1894, Serial No. 520,811. Fig. 5 is a plan view of the track-instrument, the hereinafter-mentioned registering-circuit contact-levers and the supports therefor shown in Figs. 6 and 7 being omitted for the sake of clearness. Fig. 6 is a longitudinal section thereof, taken on the irregular

section line X X of Fig. 5, looking in the direction of the arrow there shown. Fig. 7 is a transverse section taken on the line Y Y of Fig. 5 and looking in the direction of the arrow there shown and illustrating particularly the mechanism for operating the hereinafter-mentioned registering-circuit contact-points of the track-instrument. Fig. 8 is a transverse section taken on the line Z Z of Fig. 5 and looking in the direction of the arrow there shown, the mechanism shown in Fig. 7 being omitted for the sake of clearness, and shows the mechanism for operating the hereinafter-mentioned canceling-circuit contact-points of the track-instrument. Fig. 9 is an end view of the track-instrument mechanism, the mechanism shown in Figs. 7 and 8 being omitted for the sake of clearness, and illustrates a mechanism for breaking a circuit the instant wheels pass over the track-instrument and retaining the circuit broken for a considerable time after those wheels have passed off from the track-instrument, the utility of which will be hereinafter apparent; and Fig. 10 is a diagram illustrating the arrangement of the circuits and insulated track-sections and the magnets of the track-instrument by which its mechanism is operated.

Referring now to the drawings, and particularly to Fig. 1, A and B are signal-stations at the ends of a block A B of a railway-track, over which traffic proceeds in both directions.

S′ to S^8, inclusive, are signals placed at the signal-stations A and B and controlling traffic on the railway.

S^2, S^4, S^6, and S^8 are home-signals, and S′, S^3, S^5, and S^7 are distant signals corresponding each to a home-signal and placed in the same circuit.

The signals may be of any type which may be controlled by electromagnets, and in the drawings each signal is represented by the conventional representation of an electromagnet, which may be understood to be the controlling magnet of the signal. For the management of circuits herein adopted the signals are understood to be so controlled as to be at "danger" when no current is flowing through the coils of their controlling electromagnets.

The normal position of all the signals is at "danger," and the signals at the entrance of a block must be set to "safety" before a train can enter that block.

1, 2, 3, and 4 are registers such as are shown in Figs. 2, 3 and 4. Each register is represented by a group of three electromagnets, one provided with a polarized armature, corresponding to the magnets which operate the mechanism of the register, and by a set of contact-points normally closed, which are the contact-points of the register, the mechanism of which is arranged to separate said contact-points when one pair of wheels has entered the block to which the register belongs and at the station at which said register is located and to keep said contact-points separated so long as a wheel remains within the block.

In register 1, R′ is the registering-magnet or operating-magnet of the registering mechanism and is energized and de-energized each time that a wheel passes into the block. C′ is the canceling-magnet, which, as above stated, must be a magnet with a polarized armature, and is represented by the conventional designation of a "polarized relay." This magnet operates its mechanism when a train from A is passing out of the block A B at B, as will be seen subsequently. RC′ is the reverse canceling-magnet, which operates its mechanism when a train which has entered the block AB at A passes out of the block by backing past A, as will be seen subsequently.

For operating the registers there is provided at each signal-station a track-instrument such as is shown in Figs. 5 to 10, inclusive.

In Fig. 1 each track-instrument is represented, diagrammatically, by two short insulated track-sections with a battery connected therewith and conductors leading therefrom, between the ends of which conductors are placed the abbreviations "tr. in.," the track-instrument contact-points being shown in close proximity to the insulated track-sections. The track-sections of the track-instrument at station A are numbered 7 and 8 and of the track-instrument at station B are numbered 12 and 13. The combined length of each pair of track-sections under ordinary circumstances should be shorter than the distance between two adjacent axles of any car, so that each pair of wheels acts on the track-instrument separately.

16 and 17 are respectively normally-open and normally-closed sets of contact-points of the track-instrument at A, which, as will be seen when the construction and operation of the track-instrument are described, are operated each time that a pair of wheels passes over the track-instrument track-sections at A in the direction from A to B. 18 and 19 are corresponding sets of contact-points of the same track-instrument, which are operated each time that a wheel passes over that track-instrument in the direction from B to A.

20 represents a set of normally-closed contact-points or series of sets of contact-points, which are so operated by the track-instrument mechanism that they break the circuit which they control immediately upon the entrance of a pair of wheels upon the short track-section 7 and keep their circuit broken so long as that pair of wheels is upon track-sections 7 and 8 and for a short space of time at least after that pair of wheels have passed upon track-section 9.

At station B, 22, 23, 24, 25, and 26 are sets of contact-points of the track-instrument there situated, corresponding respectively to contact-points 16, 17, 18, 19, and 20 of the track-instrument at A and similarly operated.

Considering now the circuits of Fig. 1, the

registering mechanism of register 1 is operated by a circuit which runs from the positive pole of battery 30 through a conductor 31 and track-instrument contact-points 17, which are termed "registering" contact-points, through conductor 32, the coils of registering-magnet R′ and through conductor 33 back to the negative pole of battery 30. A similar circuit from battery 30, passing through registering contact-points 19 operates the registering mechanism of register 4, and similar circuits at station B, passing through registering contact-points 23 and 25, operate the registering mechanisms of registers 2 and 3. The canceling and reverse canceling mechanisms of the registers are operated by the normally-open sets of contact-points of the track-instruments. The canceling mechanism of each register is operated by the contact-points of the track-instrument at the distant end of the block, while the reverse canceling mechanism is operated by the contact-points of the track-instrument at the same end of the block at which said register is situated. The canceling-circuits of the system pass through contact-points of, and are controlled by, circuit-controllers or relays 41, 42, 43, and 44, the magnets of which are energized by local batteries and circuits passing through the circuit-controlling contact-points of the corresponding registers 1, 2, 3, and 4. As will be seen when the construction and operation of the register is described, the contact-points of each register are closed when no wheels are within the block to which such register belongs; but when a train enters a block to which a register belongs, by passing over the track-instrument track-sections at the end of the block at which said register is situated the circuit-controlling contact-points of that register are separated and can only be brought together again by operation of the canceling or reverse canceling mechanisms of that register or by the operation of both the canceling and reverse canceling mechanisms, which must, singly or together, cancel as many wheels as were registered when the train entered the block—that is, when a train enters the block A B at A it operates contact-points 17 of the track instrument each time that a wheel passes over the track-instrument rail-sections, each time operating the registering mechanism R′ of register 1. When the first wheel is registered, the contact-points 1′ of the register are separated and remain separated so long as there are any wheels registered on said register. Nor can those contact-points be brought together again until by the operation of the canceling mechanism C′ or the reverse canceling mechanism RC′, or by the operation of both of these mechanisms, as many wheels have been canceled as were first registered. It follows, therefore, that so long as any of the wheels which when entering the block registered at register 1 are within the block the armature of relay 41 must be down, and a corresponding statement will in the same manner be true of each of the other register-relays 42, 43, and 44.

Considering now the manner in which the canceling mechanisms of the registers are operated, and taking for an example the canceling mechanism of register 1, we will suppose that certain cars have entered the block A B at A and are about to pass out of the block at B. The contact-points 1′ of register 1 at A will be separated, therefore, and the armature of register-relay 41 will be down. When the first pair of wheels of the cars within the block A B pass over the track-sections 12 and 13 of the track-instrument at B, they will close for an instant contact-points 22 of that track-instrument. A circuit is thereby completed from the positive pole of battery 50 through conductor 51, contact-points 22, conductor 52, to the second armature contact-point of register-relay 43, which armature will be up, since we have assumed that the cars within the block entered from station A through the upper second contact-point of the relay 43, conductor 53, through the coils of the magnet of a pole-changer 54, and through a conductor 55 back to the negative pole of battery 50.

The pole-changer 54 is of ordinary construction. It connects a battery 56 through conductors 57 and 58 to ground at G′, whence the circuit goes through the ground to G at station A, thence through conductor 59 to the first armature-contact of register-relay 41, the armature of which is down, since the contact-points 1′ of register 1 are separated, through the lower first contact-point of the relay, through conductor 60, the magnet-coils of canceling-magnet C′ and through conductors 61 and 62, which latter is a line-conductor extending from one signal-station to the other, to the first armature-contact of register-relay 43, the armature of which is up, since no wheels are registered at register 3, thence from the upper first contact-point of the relay by conductor 63 to the armature contact-point of a relay 64, the armature of which is down, since the circuit by which this relay is operated is broken at the track-instrument contact-points 26, which, as previously explained, are so operated by the track-instruments that they break their circuit the instant when the wheels come upon track-section 12, and from the lower contact-point of relay 64 through a conductor 65 to the pole-changer 54, and so back to battery.

The position of the armature and contact-points of the pole-changer 54 (shown in the drawings) is the position of the parts when the contact-points 22 of the track-instrument are separated or when the armature of register-relay 43 is down and no current flows through the magnet of the pole-changer. The armature of the canceling-magnet C′ of register 1 is magnetized in such a manner that when no current flows through the magnet of the pole-changer 54 and the battery 56 is placed

to the line, as shown in the drawings, the armature of this canceling-magnet C′ will be held in the position shown in the drawings. A spring likewise holds it in this position when there is no current in the line-circuit; but when in passing out of the block A B a pair of wheels pass over the track-instrument track-sections 12 and 13 and complete a circuit in the manner above described through the magnet of the pole-changer 54 the direction of current in the line-circuit and in the magnet-coils of canceling-magnet C′ is reversed, the armature of the canceling-magnet is deflected, and the canceling mechanism of register 1 is operated, and as the contact-points 22 separate again immediately after the passage of each pair of wheels it follows that the canceling mechanism of register 1 is operated each time that a pair of wheels which entered the block A B at station A pass out of that block at station B.

There are corresponding circuits connecting with the line-conductors of the blocks and with the ground connections for operating the canceling mechanisms of the other registers in a similar manner, but it is not necessary to describe those circuits.

The reverse canceling mechanisms are operated in the following manner: Supposing, as before, that certain cars have entered the block A B at A, we will suppose those cars to pass out of the block by backing past A. In so doing, when the first pair of wheels pass over the track-instrument track-sections 7 and 8 they will cause contact-points 18 to close, thereby completing a circuit from the positive pole of battery 70 at station A, through conductor 71, contact-points 18, conductor 72, the second armature-contact of relay 41, the armature of which, as before, is down, through the lower second contact-point of the relay, conductor 73, through the magnet-coils of reverse canceling-magnet RC′, and through conductors 74 and 75, back to the negative pole of battery 70. This circuit will be completed for an instant each time that a pair of wheels of the train pass out of the block A B at A, thus operating each time the reverse canceling mechanism.

The relay 64 at station B, above mentioned, is a relay which controls the setting to "safety" of the signals S^5 and S^6 at station B. The line-conductor 62 of the block is connected, as has been seen, through contact-points of register-relay 43 with the armature of signal-relay 64, and the lower contact-point of the relay is always connected, through the pole-changer 54, with a pole of the battery 56, which may be termed a "line-battery." The upper contact-point of relay 64 is connected by a conductor 80, passing through the magnet-coils of signals S^5 and S^6, with the conductor 58, leading to ground at G′, and therefore with the line-circuit of the block. In the normal position of the armature of signal-relay 64 battery 56 is connected to the line-circuit, and the signals S^5 and S^6 are out of the line-circuit; but when the armature of the relay is raised battery 56 is cut out of the line-circuit and signals S^5 and S^6 are placed in the line-circuit, the only battery now in the line-circuit being the line-battery at station A. Since the signals used in this system are signals which when no current is flowing through their controlling-magnets are at "danger," but when current is flowing through their controlling-magnets are at "safety," the raising of the armature of relay 64 has the effect of setting to "safety" signals S^5 and S^6, provided the line-circuit is not broken at any of the register-relays, and provided the line-battery at A is to the line, as it will be if the armature of the signal-relay at A is down. The other signal-relays, corresponding to signal-relay 64, are numbered 81, 82, and 83. The corresponding line-batteries are numbered 84, 85, and 86, and the poles of the line-batteries are connected to pole-changers 87, 88, and 89, corresponding to the pole-changer 54 at station B. Each signal-relay is operated by a local battery and circuit passing through the rails of an insulated track-section placed immediately adjoining the track-sections of the track-instrument and through the magnet-coils of the relay. Thus the relays 81 and 83 at station A are operated by a battery 90, the negative pole of which is connected with the left-hand rails of track-sections 6 and 9, placed on opposite sides of and immediately adjoining the track-sections 7 and 8 of the track-instrument. From the right-hand rail of track-section 6 a conductor 91 leads through the magnet-coils of signal-relay 81 to the track-instrument contact-points 20 and thence back to the positive pole of battery 90. A similar conductor 92 leads from the right-hand rail of track-section 9 through the magnet-coils of relay 83 to track-instrument contact-points 20 and so back to battery. Each of these circuits is completed and the armature of the corresponding signal-relay raised when a pair of wheels is on the corresponding track-section 6 or 9 and when the track-instrument contact-points 20 are closed. The effect of the separating of contact-points 20 has already been touched upon and will be described more fully when the operation of the circuits of the system is described. Similar circuits for operating the signal-relays 82 and 64 at station B are connected to track-sections 11 and 14 at station B and are operated in a similar manner.

Of the various rail or track sections shown in the drawings 5 is the main track-section of a block immediately preceding the block A B.

6 and 9, as above stated, are track-sections for operating the signal-relays at station A, and 7 and 8 are track-sections for operating the track-instrument at station A, as has been already stated.

10 is the main track-section of the block A B, which may be of any desired length.

11 and 14 are insulated track-sections for operating signal-relays 82 and 64.

12 and 13 are track-sections of the track-instrument at B, and 15 is the main track-section of a block immediately beyond the block A B.

Before describing the operation of the circuits of the system the construction and operation of the registers and track-instruments by which the circuits are controlled and operated will first be described.

Taking up first the register and referring to Figs. 2, 3, and 4, the magnets and contact-points of which are lettered and numbered to correspond with register 1 at station A, R′ C′ and RC′ are the operating-magnets of the registering, canceling, and reverse canceling mechanisms respectively. Each of these magnets operates a step-by-step mechanism acting on a ratchet-wheel mounted on a revoluble shaft. These step-by-step mechanisms are all similar, except that the mechanism of magnet R′ is arranged to rotate its ratchet-wheel when the circuit of its magnet is broken. The mechanism of magnet RC′ is arranged to rotate its ratchet-wheel when the circuit of its magnet is closed, and the mechanism of magnet C′, which is constructed in general similarly to an ordinary polar-relay, is arranged to rotate its ratchet-wheel when the circuit of its magnet is reversed from its normal direction, this reversal being performed for register 1 of Fig. 1 by the pole-changer 54 at station B. 100, Fig. 3, is the ratchet-wheel operated by magnet R′; 101, Fig. 4, is the ratchet-wheel operated by magnet C′, and 102, Fig. 2, is the ratchet-wheel operated by magnet R C′, wheel 102 being directly in rear of and hidden by wheel 100 in Fig. 3, while wheel 100 is hidden by the framework-supporting magnet R′ in Fig. 2. The ratchet-wheels 100 and 102 are mounted upon the same shaft 104 and are acted upon by their magnets in opposite directions, one magnet and step-by-step mechanism being arranged to rotate the shaft 104 in one direction and the other magnet and step-by-step mechanism being arranged to rotate the shaft in the other direction. The ratchet-wheel of magnet C′ is mounted upon a shaft 105 in line with shaft 104, and magnet C′ when operated turns shaft 105 in the same direction that magnet 1 turns shaft 104. The end of shaft 104 adjacent to shaft 105 overhangs its bearings, is insulated from the main portion of the shaft, and is screw-threaded. Upon the threaded portion is mounted a nut 106. Upon the shaft 105 is keyed a collar 107, and upon the shaft 104 is loosely mounted a collar 108. Two rods 109 upon opposite sides of the shaft 104, and only one of which is seen in Fig. 2, connect the collars 107 and 108, passing through loosely-fitting apertures in the nut 106. The nut 106, therefore, rotates with, and only with, the shaft 105, though it is free to move longitudinally with respect to the shaft 104 when that shaft revolves. Two engaging contact-points, one carried by an arm projecting from the shaft 104 and the other carried by the nut 106, together constitute the register-contact 1′ of this register 1, which controls the signal-circuits in Fig. 1.

The operation of the register is as follows: When the magnet R′ is operated by a wheel passing over its track-instrument, such as the track-instrument at A, Fig. 1, and in the direction to operate the registering-circuit contact-points 17, the step-by-step mechanism operated by magnet R′ moves the wheel 100 and shaft 104 through the space one tooth of the wheel 100. The magnet C′ not being operated, the shaft 105 and nut 106 remain stationary, except that the nut moves slightly to the right along shaft 104 and the contact 1′ is broken, setting to "danger" the signals. Successive wheels passing over the track-instrument and operating-magnet R′ separate the contact-points 1′ still farther by a distance proportional to the number of wheels which pass into the block A B. When the wheels of the train, in passing out of the block A B at B, operate the canceling-circuit contact-points 22 of the track-instrument at B, thus operating the pole-changer 54 and changing the direction of the current in the line-conductor 62, the armature of magnet C′ rises, turning the shaft 105 and the nut 106 in the same direction in which the shaft 104 is turned, thus tending to bring the contact-points 1′ together. The number of teeth of the wheels 100 and 101 are exactly the same, so that when as many car-wheels have operated magnet C′ as first operated magnet R′ the contact-points will be together. It will be noted that magnets R′ and C′ may be operating simultaneously and at the same or different speeds without affecting the correctness of the registration and cancellation of the wheels by the register, so that one train may be entering the block A B at A while another train is passing out of the block at B without deranging the register. Should the train, after entering the block A B at A, back out of the block, passing again over the track-instrument at A, then, as will be seen when the operation of the track-instrument is described, canceling-circuit contact-points 18 are operated by each wheel, operating reverse canceling-magnet RC′ of the register, and so turning the wheel 102 and shaft 104 backward. The number of teeth on wheel 102 is the same as the number of teeth on wheel 100, so that when as many wheels have operated magnet RC′ as first operated magnet C′ the contact 1′ is again closed, the operation of magnet RC′ having exactly the same effect on the contact-points 1′ that the operation of magnet C′ has. It will be noted that magnets C′ and RC′ may be operated simultaneously, the shaft 104 turning backward while the nut 106 turns forward, both movements tending to bring the contact-points together, and the operation of the two canceling mechanisms being cumulative.

This feature of the register makes it possible for trains to be passing out of the block at both ends simultaneously, just as it is possible for a train to enter at one end of the block while another train is passing out of the block. It is important that the register used in a registering system shall be capable of operating in this manner, because it frequently happens that even on roads where the absolute block system is used trains will overrun danger-signals to a greater or less extent, and unless the registers used be capable of operating in the manner above described derangement of the registers is likely to occur. Since the step-by-step mechanisms of magnets C′ and RC′ oppose each other and when operated act to revolve the same shaft 104 in opposite directions, the pawls of these mechanisms cannot be in engagement with their respective ratchet-wheels when their mechanisms are not operating, but each pawl must engage with its ratchet-wheel only when actually engaged in rotating that wheel and the shaft 104. This is accomplished by guards 109′ engaging with these pawls and holding them out of engagement with the ratchet-wheels when the armature-levers are up. When either armature-lever descends its pawl swings into engagement with its ratchet-wheel and in the further movement of the lever rotates said wheel.

Referring now to Figs. 5, 6, 7, 8, 9, and 10, which illustrate the track-instrument, the construction and operation of this instrument will be described. The contact-points and insulated track-sections of the track-instrument shown in Figs. 5 to 10 are numbered to correspond with the track-instrument at A, Fig. 1.

The track-instrument consists essentially of three separate and distinct mechanisms, two operated by the same electromagnets, for operating the normally-closed registering circuit-contacts 17 and 19 and for operating the normally-open canceling circuit-contacts 16 and 18, these mechanisms being shown in Figs. 7 and 8, and a third mechanism, (shown in Fig. 9,) for operating the contact 20, which contact is broken when a pair of wheels pass on to the track-sections 7 and 8, and remains broken for some time after the wheels have passed off from those track-sections.

110 and 110′ are the electromagnets which operate the registering-contact and canceling-contact mechanisms. Two magnets are required, because it is necessary that in both the registering-contact and in the canceling-contact mechanisms one set of contact-points should be operated when a wheel passes over the track-instrument in one direction and another set of contact-points should be operated when a wheel passes over the track-instrument in the other direction.

The armatures 111 and 111′ of operating-magnets 110 and 110′ are carried upon frames formed by pivoted levers 112 and 113 and 112′ and 113′ and suitable connecting cross-bars. Levers 113 and 113′ carry friction-rollers 114 and 114′, which are pressed against opposite sides of an arm 115, mounted upon and keyed to a revoluble shaft 116 by suitable springs. When either lever 113 or 113′ descends, it causes the arm 115 to swing to the one side or the other. Upon the shaft 116, but insulated therefrom, is mounted a contact-lever 117. Engaging with said contact-lever and with a contact-screw 118, likewise insulated from its support, is a contact-lever 119. The engaging contact-points of levers 117 and 119 constitute the registering-circuit contact 17, and the engaging contact-points of screw 118 and lever 119 constitute the registering-circuit contact 19, one contact being broken, as will be seen, when the arm 115 swings to the right and the other being broken when the arm swings to the left. Springs 120 and 121 are provided for holding the contact-points in contact when neither lever 113 nor 113′ is down, and suitable stop-screws are provided for limiting the upward movement of armature-levers 113 and 113′.

In the bottom of the swinging arm 115 are three notches, 123, 124, and 125, separated by suitable projections or wards. Two pivoted locking-levers 126 and 126′, carrying armatures of magnets 127 and 127′, are adapted to enter one of said notches when it is opposite the end of the lever and when the magnet of said lever is de-energized. Normally, as will be seen hereinafter, the circuits of these locking-magnets are closed and their armatures are down, but when wheels pass over the track-instrument first one and then the other magnet is de-energized.

Considering now the canceling-circuit contact mechanism shown in Fig. 8, levers 112 and 112′, which, as before stated, are attached to the armatures of magnets 110 and 110′, carry pawls 130 and 130′, which engage with corresponding ratchet-wheels 131 and 131′, revolubly mounted, but independent of each other. Each ratchet-wheel is likewise provided with a stop-pawl 132 or 132′, which serves as a contact-lever, engaging each with a contact-strip 133′ or 133, carried by the lever 112′ or 112 of the other ratchet-wheel. The shape of these contact-strips is shown most clearly in Fig. 5. Stop-pawl 132 and contact-strip 133′ together form canceling-circuit contact 16, and pawl 132′ and contact-strip 133 together form canceling-circuit contact 18.

As will be seen hereinafter, when a train entering the block A B at A operates canceling-circuit contact 16 or when a train from B, passing out of the block A B at A, operates canceling-circuit 18, it is necessary that the armature of signal-relay 83 or 81, as the case may be, shall be down, in order that the pole-changer operated by the canceling-circuit contact may be in circuit with the canceling mechanism of the register at the other end of the block. The canceling-circuit contacts 16 and 18 are closed for an instant only after,

and only after, the passage of each pair of wheels completely over the track-instrument track-sections. In order that the armature of relays 81 and 83 may be down at the instant when the canceling-circuit is operated, it is necessary that the circuits of their magnets shall be broken as soon as a pair of wheels passes on to track-sections 7 and 8 and shall remain broken for an appreciable instant after the wheels have passed off from track-sections 7 and 8. The mechanism for accomplishing this purpose is illustrated particularly in Fig. 9. It consists, essentially, of two magnets 141 and 141′, which preferably should be in the same circuits with magnets 110 and 110′, respectively, as shown in Fig. 10, and which are placed upon opposite sides of a revolubly-mounted fine-toothed ratchet-wheel 142. The magnets are provided with armatures and armature-levers therefor, carrying on their ends pawls 143 and 143′, engaging with the teeth on this ratchet-wheel. The magnets, armature-levers, and pawls are so set that both step-by-step mechanisms, when operated, tend to turn the ratchet-wheel in the same direction. The armature-levers are provided with suitable stop-screws and with contact-points 144 and 144′, adapted to engage with suitable contact-screws 145 and 145′. The two contacts thus formed are connected up in series, as shown in Fig. 9, so that when either contact is broken the circuit is broken. Since, therefore, their effect is that of one set of contact-points, they are represented diagrammatically in Fig. 1 by the single contact 20 at A and 26 at B. The stop-screws should be so adjusted that the normal travel of the armature-levers is several times the pitch of the teeth on the ratchet-wheel 142.

A fan-wheel 146 is connected by suitable gearing to the shaft upon which ratchet-wheel 142 is mounted. The effect of this fan-wheel is to supply a constant resistance to the revolution of the ratchet-wheel without friction, thereby forcing the armature-levers to move slowly when attracted by their magnets, and so causing a perceptible time to elapse after the circuits of these magnets are completed before the circuit is completed through the contacts of this fan mechanism.

The circuits and insulated track-sections for operating the magnets of the track-instrument are shown diagrammatically in Fig. 10. There are in the track two insulated track-sections 7 and 8, to which are connected the poles of a battery 135, through resistance-coils 136 and 136′. Upon one side of the track the rails of these two track-sections may be joined. To the end of track-section 8 is connected a conductor 137, connected to magnets 110, 127, and 141. To the ends of track-section 7 is connected a conductor 137′, connected to magnets 110′, 127′, and 141′. These circuits, it will be seen, are normally closed through these magnets.

The operation of my track-instrument is as follows: When the first pair of wheels of a train pass upon one of the insulated track-sections—say, track-section 7—battery 135 is short-circuited through the axle, de-energizing magnets 127′ and 110′. The armature 111, Fig. 7, of magnet 110′ therefore falls, and the roller 114′ swings pivoted arm 115 to the right, thus separating contact-levers 117 and 119 and breaking registering-circuit contact 17. At the same time the locking-lever 126′ is released by its magnet, and when the notch 125 of the arm 115 is opposite the end of this lever the end of the lever enters the notch, thus holding the contact-levers apart. The circuit through magnets 110, 127, and 141 is not affected when wheels enter track-section 7, since the resistance of coil 136′ is sufficient to prevent total short-circuiting of battery 135. When the wheels pass upon track-section 8 magnets 127, 110, and 141 are de-energized and magnets 127′, 110′, and 141′ are again energized. The armature of magnet 110′ rises and the armature of magnet 127′ falls; but before arm 115 can move the lever 126 enters notch 124, again locking the arm 115, so that the descent of armature 111 does not change the position of the registering-circuit contact-points. When the wheels have passed off from track-section 8, the armature 111 rises, and the armature of magnet 127 falls, releasing the arm 115 and closing contact 17, so that the registering-contact mechanism is ready to be operated when another pair of wheels pass over the track-instrument in either direction.

It will be noted from the above description that the one registering-circuit contact or the other, according to the direction in which the train is moving, is broken the instant a pair of wheels pass onto one of the insulating track-sections, remains broken while that pair of wheels is on either of the insulated track-sections, and is closed again immediately after that pair of wheels has passed off from the insulated track-sections, so that even if the wheels should move but partly over the insulated track-sections and then should move back again, but one registering-circuit contact—the one first operated when the wheels passed upon the track-instrument track-sections—would be operated, and it is impossible that a single pair of wheels should operate a register twice or operate two registers in passing once onto or over the track-instrument.

When the first pair of wheels pass upon track-section 7, and the armature of magnet 110′ falls, the pawl 130′ upon the end of lever 112′, Fig. 8, is carried down through the space of one tooth of ratchet-wheel 131′. When this pair of wheels pass to track-section 8, the armature of magnet 110, lever 112, and pawl 130 descend, and the armature of magnet 110′, lever 112′, and pawl 130′ rise, revolving the ratchet-wheel 131′ through the space of one tooth, and causing contact-pawl 132′ to descend slightly as it passes over a tooth of the ratchet-wheel. The pawl 132′

does not come in contact with the contact-strip 133, (its complementary contact-piece,) however, as the lever 112 which carries that contact-strip is down, and therefore contact 18 (the canceling-circuit contact) is not closed. When the wheels pass off from track-section 8, and into the succeeding block, lever 112 rises, ratchet-wheel 131 is revolved through the space of one tooth, and contact-pawl 132 descends, making contact with contact-strip 133′, since lever 112 is up, thus closing canceling-circuit contact 16 for an instant and operating the canceling mechanism of the register connected therewith.

If a pair of wheels pass onto track-section 7, and then without moving onto track-section 8 moves back again registering-circuit contact 17 is broken, as would be the case were the wheel to move on and completely over the track-instrument track-sections; but since magnet 110 in this case is not de-energized its lever 112 does not fall, and when lever 112′ rises contact 18 is closed, thus operating the canceling-circuit for the reverse movement, the effect of which is, as will be seen when the operation of the circuits of Fig. 1 is described, to cancel the registration just produced by the operation of contact 17. The same is true if the pair of wheels move from track-section 7 to 8, and then without moving backward move back into track-section 7, and so off from the track-instrument.

When the first pair of wheels pass upon track-section 7, magnet 141′ is de-energized and its armature rises, breaking the circuit through contact 20. When the wheels pass on into track-section 8, magnet 141 is de-energized and its armature falls, while magnet 141′ is again energized and its armature descends, rotating wheel 142 and fan 146. The fan offers so much resistance to rapid movement of the lever, however, without interfering with a comparatively-slow movement thereof that the movement of the armature of magnet 141′ is comparatively slow. When the car-wheels pass off from track-section 8, magnet 141 is again energized and its armature rises, imparting an additional impulse to wheel 142 and fan 146. The resistance offered by the fan to rapid movement of the armature-lever is so great, however, that the armature-lever can rise but slowly, and before both contacts 20 of the fan mechanism can be closed the canceling-circuit contact 16 has been operated, and to keep the circuit through contacts 20 broken while the canceling-circuit contact of the track-instrument is being operated is, as will be seen hereinafter, the purpose of the fan mechanism.

The operation of the circuits of this system is as follows: Supposing the block A B and track-sections 6 and 14, immediately without the block, to be clear of trains, and supposing a train on track-section 5 desiring to enter the block A B to pass onto the track-section 6, when the first pair of wheels of the train enters track-section 6 the circuit from battery 90, passing through the magnet of signal-relay 81, will be completed through these wheels and the axle, since at this time track-instrument contact-points 20 are closed, and the armature of signal-relay 81 will rise, thereby placing in the line-circuit signals S′ and S² and cutting out of the line-circuit battery 84. Battery 56 at station B being in the line-circuit, signals S′ and S² will go to "safety" and the train will proceed past the said signals and over the track-instrument, track-sections 7 and 8, into the block A B. When the first pair of wheels of the train pass over these track-sections 7 and 8, the track-instrument contact-points 17 are instantly separated by the mechanism of the track-instrument, thereby causing the registering mechanism of register 1 to register the entrance of one pair of wheels into the block, thus separating the contact-points 1′ of the register and causing the armature of register-relay 41 to fall, thereby cutting signals S′ and S² out of the line-circuit of the block and setting those signals again to "danger." The fall of the armature of register-relay 41 completes the line-circuit through the canceling-magnet C′, so that when the train passes out of the block at B it will cancel at register 1 and likewise places reverse-canceling magnet RC′ into circuit with track-instrument contact-points 18, so that should the train pass out of the block by backing past A it will then cancel at register 1. At the same instant when the first pair of wheels enter track-section 7 the track-instrument contact-points 20 are separated and remain separated while the wheels are on track-sections 7 and 8, and for an instant, at least, after the wheels have passed on into track-section 9, thereby causing the armature of signal-relay 81 to fall, and preventing the rise of the armature of signal-relay 83 upon the other side of the track at the moment when the first wheels enter the track-section 9. When the first pair of wheels pass over track-sections 7 and 8, the track-instrument contact-points 16 are operated, as well as contact-points 17, being brought together momentarily, and a circuit is completed from battery 70 through contact-points 16 and the magnet of the pole-changer 89. Since the armature of relay 83 is down at the instant when contact-points 16 and pole-changer 89 are operated, owing to contact 20 being broken at that instant, as explained when the operation of the track-instrument was described, the operation of the pole-changer at the instant when contact 16 is closed reverses the current in the line-circuit of the block preceding block A B, and again reverses and returns to normal direction the current in this line-circuit when contact 16 is again broken, thereby operating the canceling mechanism of the register at the distant end of the block preceding A B. The second pair of wheels of the train register in the same manner as the first pair. They likewise cancel in the same manner, for, although wheels are now

on the track-section 9, the circuit passing through the magnet of signal-relay 83 is always broken at contact-points 20 before the contact-points 16 are brought together, so that at such times the armature of relay 83 must be down. Succeeding wheels will likewise register at register 1, and will cancel at the station preceding A.

When the train reaches station B and passes onto track-section 11 it raises the armature of signal-relay 82 and set signals S^3 and S^4 to "safety," provided the block beyond B is clear, in the same manner in which signals S^1 and S^2 were set to "safety." As the wheels pass over the track-instrument track-section 12 and 13 contact-points 22, 23, and 26 are operated by each pair of wheels. The operation of contact-points 23 operates the registering mechanism of register 2, causing the setting to "danger" of signals S^3 and S^4. The operation of contact-points 22 completes a circuit through the magnet of pole-changer 54, thereby operating the pole-changer and changing the direction of the current from battery 56 in the line-wire, thereby deflecting the armature of canceling-magnet C′ at station A each time that a pair of wheels pass out of the block A B. When the same number of wheels have canceled that were first registered, the contact-points of register 1 are brought together and the armature of register-relay 41 rises, the circuits and instruments being then in the same condition as before the train entered track-section 6.

If, instead of passing out of the block A B at B, the train should back out of the block at station A, it will operate canceling contact-points 18, each pair of wheels completing a circuit from battery 70 through contact-points 18, the lower second contact of register-relay 41, (the armature of this relay being down,) reverse-canceling magnet RC′, and conductor 75, thereby canceling at register 1, and since the canceling and reverse-canceling circuits and mechanism are quite distinct it follows that if the train breaks in two within the block and part goes out at one end and part at the other end, all of the wheels will be correctly canceled, even though the two parts of the train should pass out of the block simultaneously.

If, while the train is within the block A B, a following train comes upon track-section 6 with the intention of entering the block it will raise the armature of relay 81, but cannot set signals S′ and S^2 to "safety," since the line-circuit is broken at the upper first contact of register-relay 41, the armature being down; nor can a train on track-section 14 at station B receive a signal to enter the block A B while there is a train from A already within the block, because the fall of the armature of register-relay 41 cuts out of the line-circuit battery 84 the only battery by which signals S^5 and S^6 can be operated. The train within block A B is fully protected, therefore, so long as a single pair of its wheels remain within the block.

The function of the track-instrument contacts 20 at station A and 26 at station B will now be apparent. If, when a train passes out of the block A B at B, for instance, the contact 26 were not always broken at the instant contact 22 is operated, then as soon as wheels have entered the track-section 14 the armature of signal-relay 64 would be raised, throwing the pole-changer 54 out of the line-circuit of block A B, so that the operation of the pole-changer upon the closing of contact 22 would have no effect upon the canceling mechanism C′ of register 1. Contacts 26 and 20 are so operated, however, as has already been explained, that each is broken at the instant when wheels passing over its track-instrument operate the canceling-circuit contact-points of that track-instrument. In general contacts 26 and 20 will not be continually opening and closing during the passage of a train, unless that train be moving very slowly, the fan-wheel 146 offering so much resistance to the rise of the armature-levers of magnets 141 and 141′ that before either armature-lever can close its contact a second pair of wheels will have passed over the track-instrument and both magnets of the fan mechanism will be again energized.

Instead of grounding the ends of the line-circuit at G and G′ a metallic return-conductor may of course be employed; and where there is any danger of the signal-conductors and telegraph or other conductors crossing the use of a metallic return may be advisable.

If it is not desired to register in so small units as the separate wheels of the cars, the herein-described system may be arranged to operate by registering the separate trairs themselves as units, by using track-instrument track-sections longer than the length of the longest cars. Each train will then cancel when its last car has passed over the track-instrument at the distant end of the block. The system as so arranged offers as complete security as where it is arranged to register the separate wheels, except that it does not provide for the possibility of a train breaking in two within the block and part remaining within the block, while the remainder, passing out of the block, cancels as though the whole train had passed out. Where the trains are registered as units, however, it is not required to use track-instruments or registers which operate as rapidly as is required where the separate wheels are registered, and this may be a controlling advantage under some circumstances; also, instead of using track-sections for operating the mechanism of the track-instrument, separate contact-pieces may be placed along the track and arms projecting from one or more of the cars of the train may be caused to make contact with these contact-pieces and so operate the track-instrument in the same manner that it is operated by the

track-sections and circuits indicated in the drawings of this application. With such an arrangement it is possible to register either separate cars or the complete train as a unit, according as to whether all or only one of the cars of the train are provided with such contact-arms. Similarly it may be possible to use track-sections of such length that the individual trucks of the cars will be registered as units. I do not limit myself, therefore, to registering the wheels themselves as units, but may likewise arrange the apparatus and circuits of my system for registering either single trucks, cars, or complete trains as units.

Other forms of track-instruments than that indicated in the drawings of this application may likewise be used—as, for instance, track-instruments operated by rail-levers, which are depressed or otherwise actuated by the wheels or by projecting arms of the cars.

I do not limit myself to the use of the track-instrument shown and described in this application, therefore, in connection with the circuits of this system, but may use any track-instrument capable of operating the circuits in a similar manner. Neither do I limit myself to the use of the register herein shown and described, but may use any register capable of performing the same functions.

It is obvious that instead of using a magnet with polarized armature for operating the canceling mechanism of the register, I may use a simple magnet with unpolorized armature, such as is used for operating the registering and reverse canceling mechanisms, the magnet being placed in a local circuit controlled by a polar-relay of ordinary construction, the magnet of this polar-relay being connected to the canceling-circuits in the same manner as indicated for the magnets C' C^2, &c. When the canceling mechanism is constructed as shown in Fig. 4, a spring to retain the armature-lever in one position normally, as indicated in Fig. 1, is not necessary, the weight of the armature-lever being sufficient for this purpose.

If it is not desired that this system shall be automatic, the track-sections 6, 9, 11, and 14 may be dispensed with, and suitable circuit-controllers, such as hand-keys, may be used for operating the circuits controlling the signal-relays. In such cases the registers act as checks upon the operators controlling the signals, making it impossible for an operator to set to "safety" the signals of a block unless that block is entirely clear.

Having thus completely described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an electrical railway signaling system, the combination, with a block or section of track, signals for the ends of said block, a line circuit for the block, a line battery for each end of the block, and a circuit controller or switch for each end of the block connected to the signal and to the battery of that end of the block, and to the line circuit conductor, and adapted to place either said signal or said battery in circuit with the line circuit, of a register at each end of said block arranged to register the passage of trains into said block and to cancel the passage of trains out of said block, and means operated by said registers for controlling said signals, and adapted to hold said signals to danger while a train is registered on said registers, substantially as described.

2. In an electrical railway signaling system, the combination, with a block or section of track, signals for the ends of said block, a line circuit for the block, a line battery for each end of the block, and a circuit controller or switch for each end of the block connected to the signal and to the battery of that end of the block, and to the line circuit conductor, and adapted to place either said signal or said battery in circuit with the line circuit, of a register at each end of said block, arranged to register the passage of trains into said block and to cancel the passage of trains out of said block, contact points operated by said registers, and circuits controlled by said contact points for operating said signals and arranged to hold said signals to danger while a train is within said block, substantially as described.

3. In an electrical railway signaling system the combination, with a block or section of track, signals for the ends of said block, a line circuit for the block, a line battery for each end of the block, a relay for each end of the block connected to the signal and to the battery of that end of the block, and to the line circuit conductor and adapted to place either said signal or said battery in circuit with the line circuit, an insulated track-section at each end of said block, and a battery and circuit connected to the rails of each track-section and to the corresponding relay and adapted to operate said relay when cars are on said track-section, of a register at each end of said block arranged to register the passage of trains into said block and to cancel the passage of trains out of said block, and means operated by said registers for controlling said signals and adapted to hold said signals to danger while a train is registered upon said register, substantially as described.

4. In an electrical railway signaling system, the combination, with a block or section of track, signals normally at danger for the ends of said block, a line circuit for the block, a signal battery for each end of the block and a circuit controller or switch for each end of the block connected to the signal and to the battery of that end of the block, and to the line circuit conductor, and normally connecting said battery to the line circuit, but adapted when operated, to place said signal in circuit with the line circuit and to place said battery out of circuit with the line circuit, of a register for each end of the block, arranged to register the passage of trains into said block and to cancel the passage of trains out of said block, and means, operated by

each register, for throwing the signals and battery at its end of the block out of the line circuit when a train is registered on such register, substantially as described.

5. In an electrical railway signaling system the combination, with a block or section of track, signals normally at danger for the ends of said block, a line circuit for the block, a signal battery for each end of the block, and a circuit controller or switch for each end of the block connected to the signal and to the battery of that end of the block and to the line circuit conductor, and normally connecting said battery to the line circuit, but adapted when operated to place said signal in circuit with the line circuit and to place said battery out of circuit with the line circuit, of a register for each end of the block, arranged to register the passage of trains into said block and to cancel the passage of trains out of said block, contact points operated by each register and arranged to be separated when trains are registered thereon, a relay for each register operated by a circuit controlled by the register contact points, and contact points of each register relay arranged to throw the signal and battery corresponding thereto out of the line circuit when the register contact points are separated, substantially as described.

6. In an electrical railway signaling system the combination, with a block or section of track, a signal for one end thereof and a register corresponding to said signal and having a registering and a canceling mechanism, said canceling mechanism being operated by a magnet having a polarized armature, of a track-instrument at the near end of said block arranged to operate said registering mechanism, a line circuit extending through the block, and connected to the magnet of said canceling mechanism, a battery at the distant end of said block, a pole changer connecting said battery to said line circuit and adapted when operated to reverse the connection of said battery to said line circuit, a track-instrument at the distant end of said block, a circuit controlled thereby for operating said pole changer, and means, operated by said register, for holding the said signal to danger while trains are registered on said register, substantially as described.

7. In an electrical railway signaling system the combination, with a block or section of track, a signal for one end thereof, a register corresponding to said signal, and having electrically operated registering and canceling mechanisms, said canceling mechanism being operated by a magnet having a polarized armature, of a track-instrument at the near end of said block, a circuit controlled thereby for operating said registering mechanism, a line circuit extending through the block, and connected to the magnet of said canceling mechanism, a battery at the distant end of said block, a pole changer connecting said battery to said line circuit and adapted when operated to reverse the connection of said battery to said line circuit, a track-instrument at the distant end of said block, a circuit controlled thereby for operating said pole changer, and means, operated by said register, for holding the said signal to danger while trains are registered on said register, substantially as described.

8. In an electrical railway signaling system the combination, with a block or section of track, a signal for each end of said block, a line circuit for the block, a line battery for each end of the block, and a circuit controller or switch for each end of the block connected to the battery and to the signal of its end of the block, and to the line circuit conductor, and adapted to place either said battery or said signal in circuit with the line circuit, of a register for each end of the block having a registering and a canceling mechanism, a track-instrument at each end of the block arranged to operate the registering mechanism of the register of its end of the block, means operated by each register, when a train is registered upon it, for throwing the magnet of the canceling mechanism into the line circuit and for throwing the line battery and the signal at its end of the block out of connection with the line circuit, and means, operated by each track-instrument, for operating the canceling mechanism of the register of the opposite end of the block through such line circuit, substantially as described.

9. In an electrical railway signaling system the combination, with a block or section of track, a signal for each end of said block, a line circuit for the block, a line battery for each end of the block, and a circuit controller or switch for each end of the block, connected to the battery and to the signal of its end of the block, and to the line circuit conductor, and adapted to place either said battery or said signal in circuit with the line circuit, of a register for each end of the block having a registering and a canceling mechanism, the canceling mechanism being operated by a magnet having a polarized armature, a track-instrument at each end of the block arranged to operate the registering mechanism of the register of its end of the block, means operated by each register, when a train is registered upon it, for throwing the magnet of its canceling mechanism into the line circuit and for throwing the line battery and the signal of its end of the block out of connection with the line circuit, a pole changer for each line battery adapted to reverse the connection of that battery with its circuit, and means, operated by each track-instrument, for operating the pole changer of its end of the block, substantially as described.

10. In an electrical railway signaling system, the combination, with a block or section of track, a signal for each end of said block, a line circuit for the block, a line battery for each end of the block and a circuit controller or switch for each end of the block, connected

to the line battery and to the signal of its end of the block, and to the line circuit conductor, and adapted to place either said battery or said signal in circuit with the line circuit, of a register for each end of the block having electrically operated registering and canceling mechanisms, a track-instrument at each end of the block, a circuit controlled thereby for operating the registering mechanism of the register at its end of the block, means operated by each register, when a train is registered upon it, for throwing the magnet of its canceling mechanism into the line circuit, and for throwing the line battery and the signal at its end of the block out of connection with the line circuit, and means operated by each track-instrument, for operating the canceling mechanism of the register at the opposite end of the block through such line circuit, substantially as described.

11. In an electrical railway signaling system, the combination, with a block or section of track, a signal for each end of said block, a line circuit for the block, a line battery for each end of the block, a relay for each end of the block, connected to the signal and to the line battery of that end of the block, and to the line circuit conductor and adapted to place either said signal or said battery in circuit with the line circuit, an insulated track-section at each end of said block, and a battery and circuit connected to the rails of each track-section and to the corresponding relay, and adapted to operate said relay when cars are on said track-section, of a register for each end of the block having a registering and a canceling mechanism, a track-instrument at each end of the block arranged to operate the registering mechanism of the register of its end of the block, means operated by each register, when a train is registered upon it, for throwing the magnet of its canceling mechanism into the line circuit and for throwing the line battery and the signal at its end of the block out of connection with the line circuit, and means, operated by each track-instrument, for operating the canceling mechanism of the register at the opposite end of the block, through such line circuit, substantially as described.

12. In an electrical railway signaling system, the combination, with two or more consecutive blocks or sections of track, a signal for each end of each block, a line circuit for each block, a line battery for each end of each block, a line relay for each end of each block connected to the signal and to the line battery at its end of the block, and to the line circuit conductor of that block, and adapted to place either said signal or said battery in circuit with said line circuit, an insulated track-section for each relay included within the length of the adjacent block, and a battery and circuit connected to the rails of each such track-section and to the corresponding relay, and adapted to operate said relay when cars are on said track-section, of a register for each end of each block having electrically operated registering and canceling mechanisms, track-instruments at the ends of said blocks between said insulated rail sections, each track-instrument adapted to operate different circuits according to the direction in which trains pass over said track-instrument, a circuit controlling the registering mechanism of each register and arranged to be operated by the track-instrument of that end of that block to which said register belongs, when a train passes over said track-instrument into said block, means, operated by each register, when a train is registered upon it, for throwing the magnet of its canceling mechanism into the line circuit and for throwing the line battery and the signal at its end of the block out of connection with the line circuit, means, operated by each track-instrument, for operating the canceling mechanisms of the registers at the distant ends of the adjacent blocks through the line circuits of those blocks and means, operated by each track-instrument, for holding at normal the armatures of the home line relays while wheels are over said track-instrument, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

THOS. B. DIXON.

Witnesses:
H. M. MARBLE,
J. ALEX. STITT.