(No Model.) 4 Sheets—Sheet 1.

L. C. WERNER.

ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS.

No. 605,941. Patented June 21, 1898.

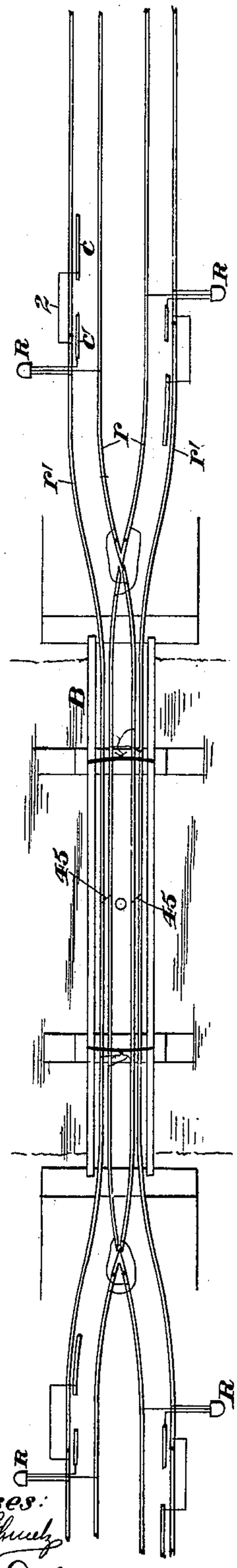

Fig. 1.

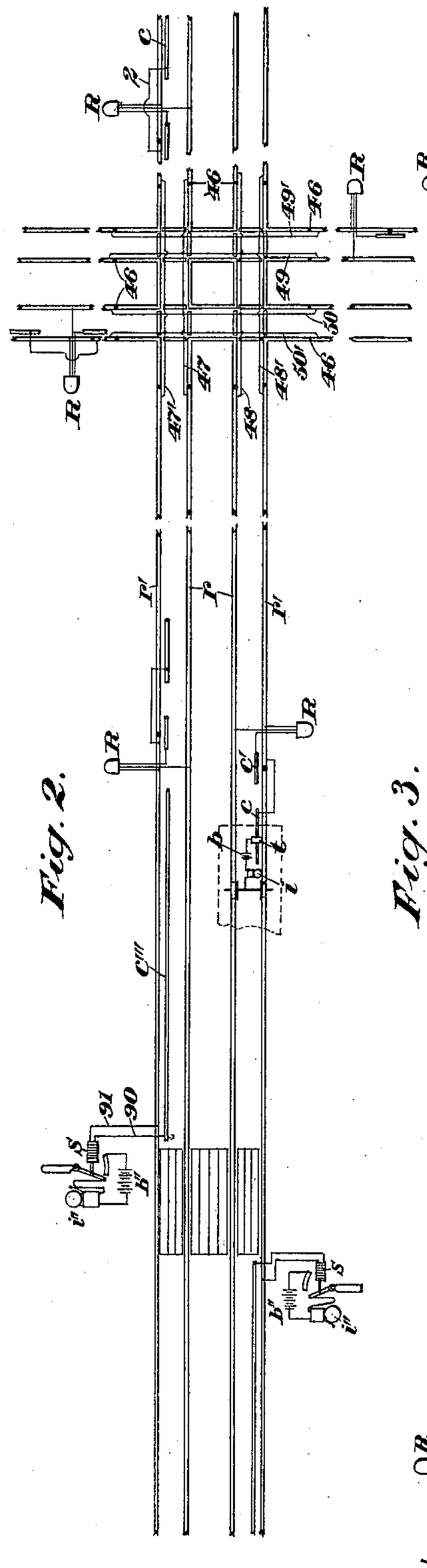

Fig. 2.

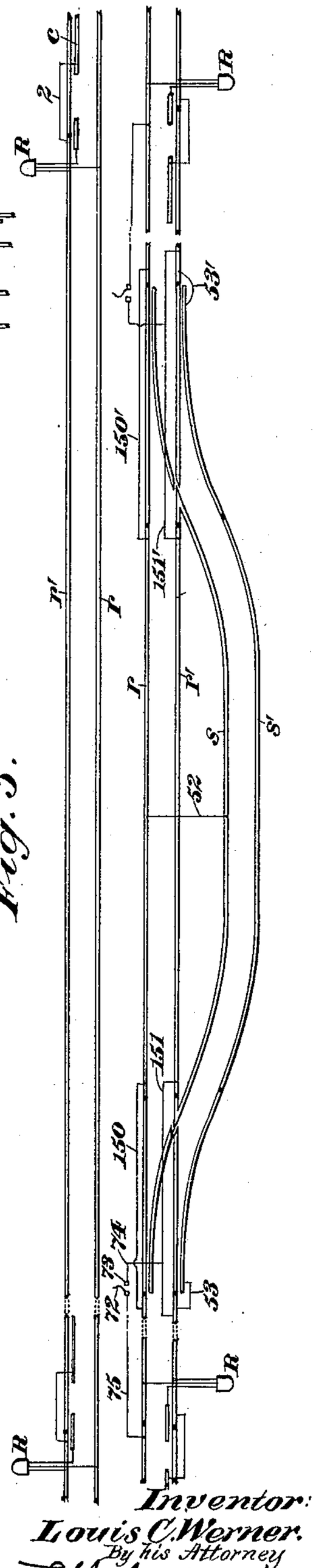

Fig. 3.

Witnesses:
Chas. F. Schmelz
Fred. J. Dole.

Inventor:
Louis C. Werner.
By his Attorney
F. A. Richards.

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L. C. WERNER.

ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS.

No. 605,941. Patented June 21, 1898.

Fig. 4.

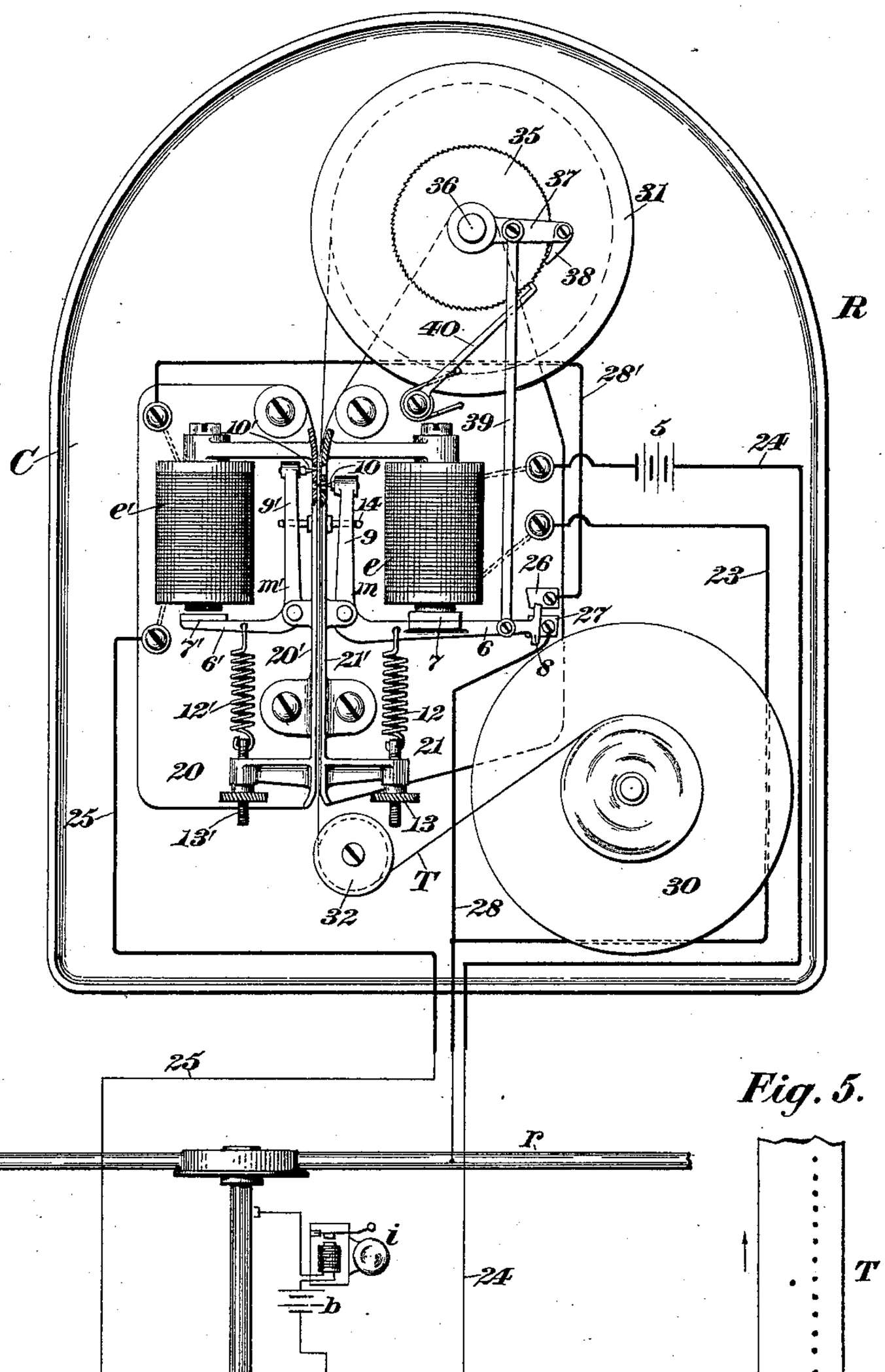


Fig. 5.

Witnesses
Chas. F. Schmelz
Fred. J. Dole.

Inventor:
Louis C. Werner
By his Attorney
F. H. Richards.

(No Model.) 4 Sheets—Sheet 3.

L. C. WERNER.

ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS.

No. 605,941. Patented June 21, 1898.

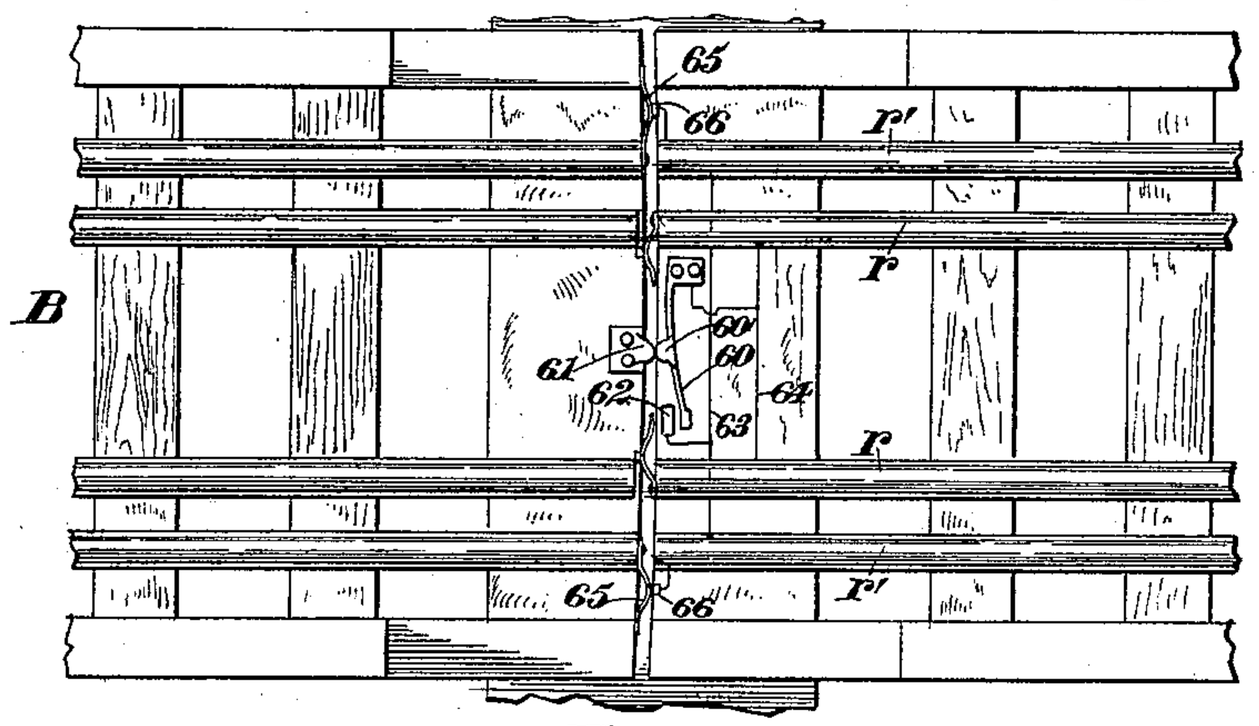


Fig. 8.

Fig. 6.

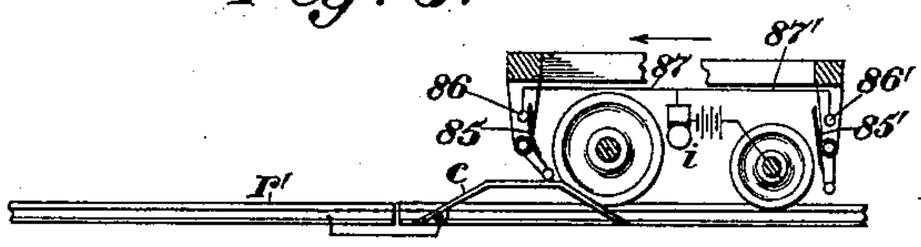


Fig. 7.

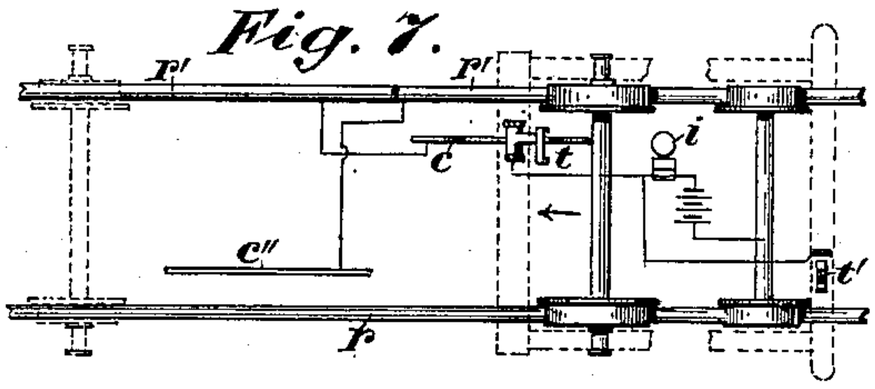


Fig. 9.

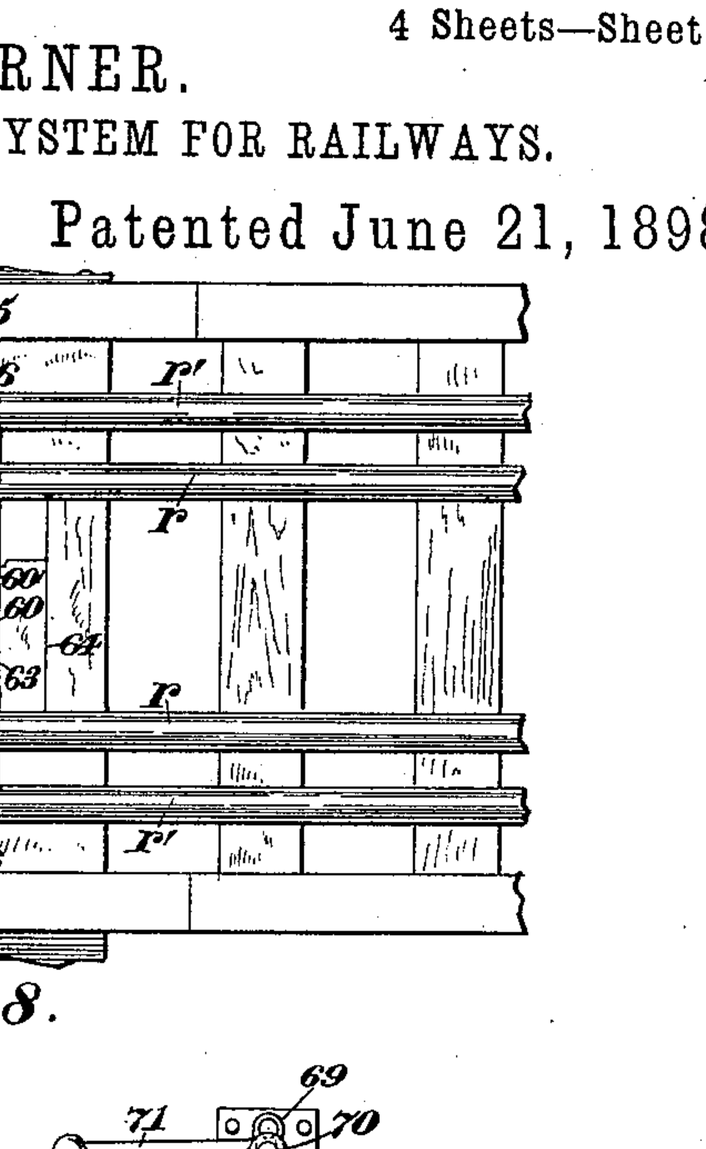
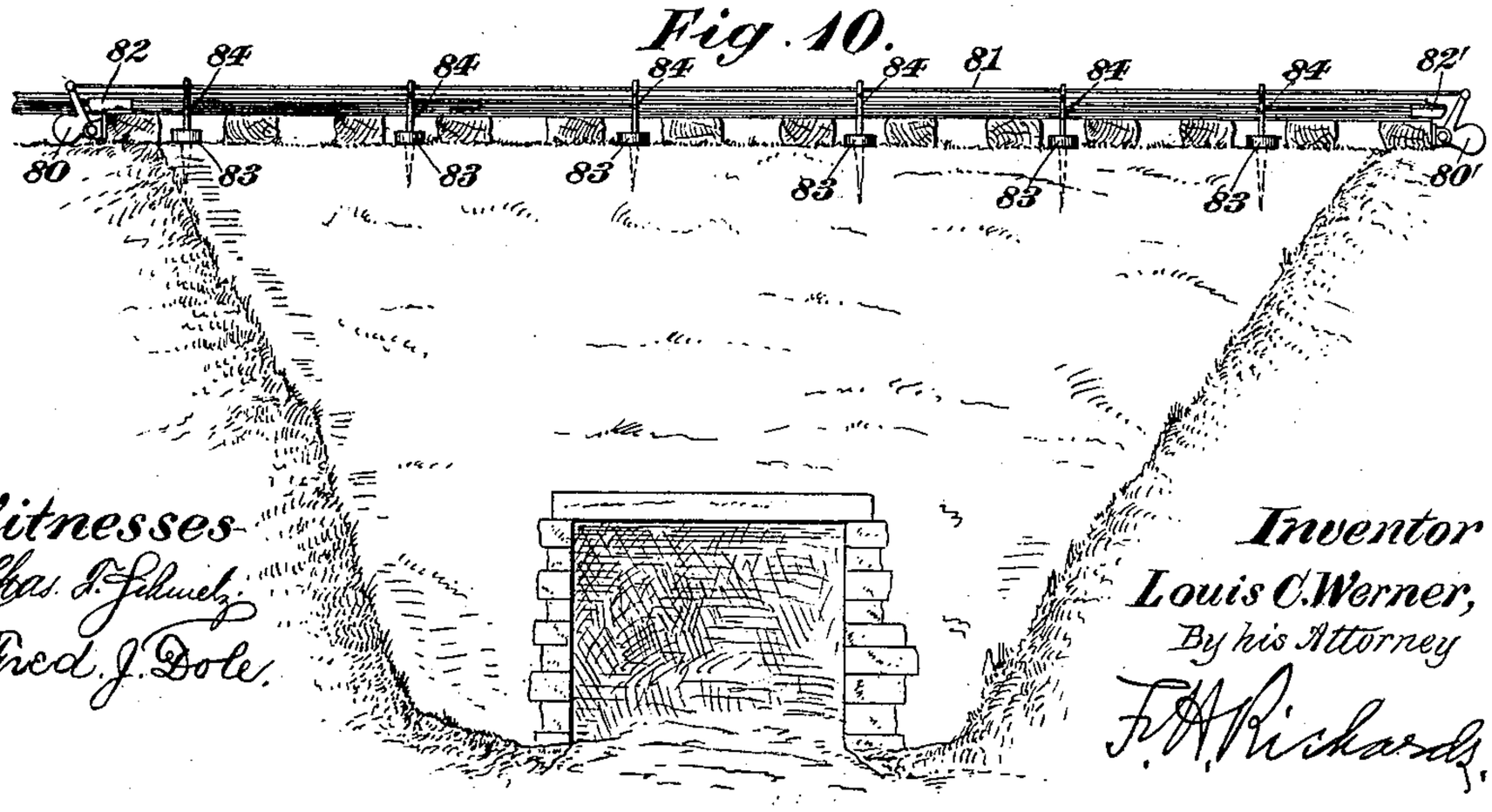


Fig. 10.



Witnesses
Chas. D. Schmelz.
Fred. J. Dole.

Inventor
Louis C. Werner,
By his Attorney
F. A. Richards.

(No Model.) 4 Sheets—Sheet 4.

L. C. WERNER.

ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS.

No. 605,941. Patented June 21, 1898.

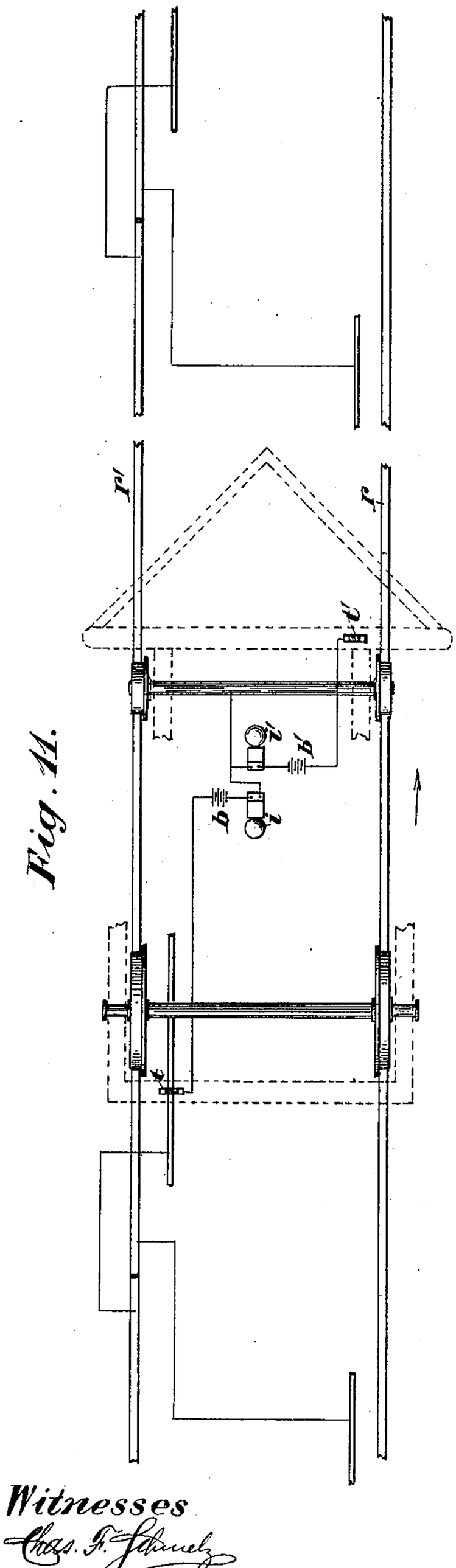


Fig. 11.

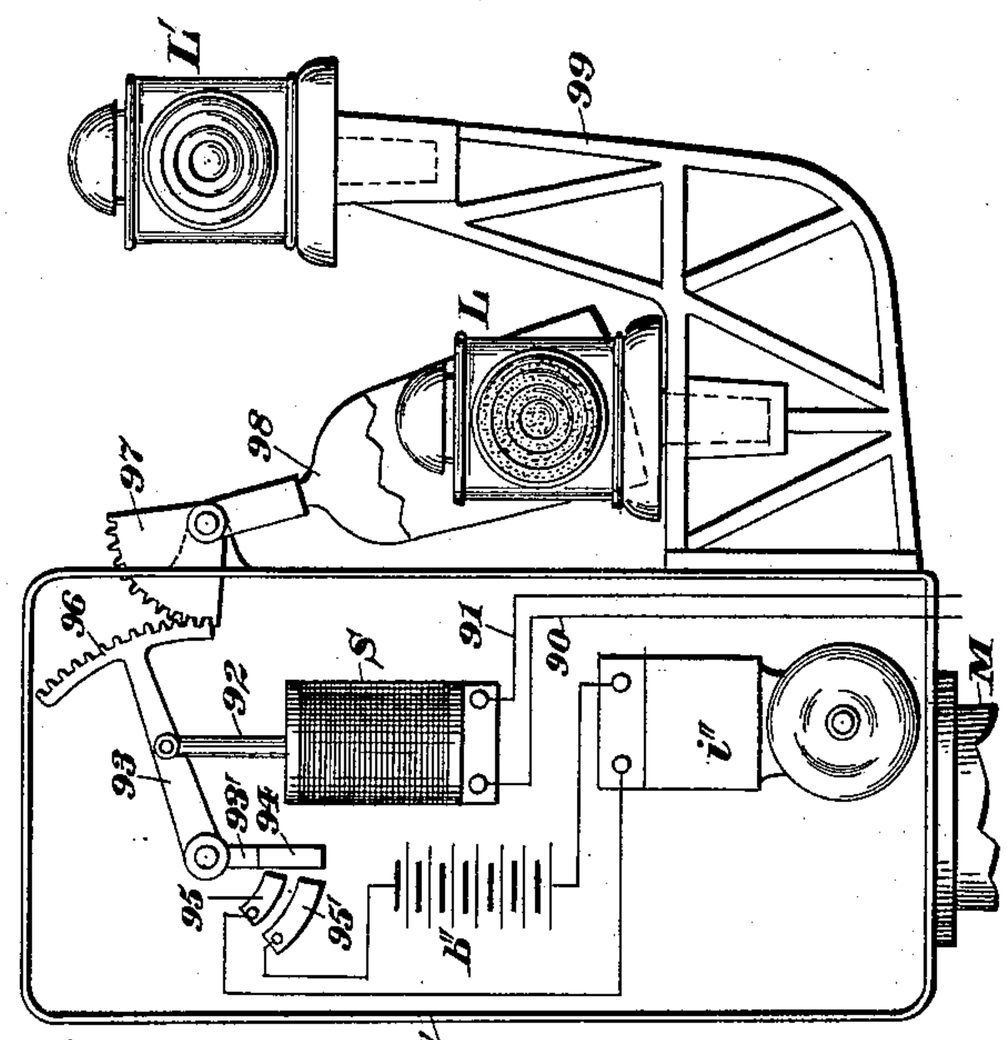


Fig. 12.

Witnesses
Chas. F. Schmelz
Fred. J. Dole.

Inventor
Louis C. Werner
By his Attorney
F. W. Richards.

UNITED STATES PATENT OFFICE.

LOUIS C. WERNER, OF BROAD BROOK, CONNECTICUT.

ELECTRIC BLOCK-SIGNAL SYSTEM FOR RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 605,941, dated June 21, 1898.

Application filed July 22, 1897. Serial No. 645,495. (No model.)

To all whom it may concern:

Be it known that I, LOUIS C. WERNER, a citizen of the United States, residing in Broad Brook, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Electric Block-Signal Systems for Railways, of which the following is a specification.

This invention relates to electric block-signal systems for railways; and it has for its main object the provision of an automatic electric signal system of this type by means of which when a train or vehicle is about to leave a block a signal will be transmitted to the engineer in the cab if the block in advance of him is not clear.

Another important object of the invention is to provide, in connection with a block-signal system such as that described, track instruments in the form of electrical recorders having means for registering the passage of each train onto a block. In this system a series of these recorders will be provided, one for each block of a double-track road; and it is one of the principal objects of this invention to furnish a recorder that will not only indicate the passage of each train over a block, but will also show whether an engineer has entered a block prematurely with his train after receiving a signal showing the presence of another train on such block in advance of him. The track instrument which I prefer to employ for this purpose will be contained within a closed casing at the side of the road-bed and electrically connected with the tracks and located in a suitable position. In this instance it will contain a recording-tape, which may be advanced in any suitable manner and upon which records may be made by suitable recording devices, one such device being provided for the purpose of registering the proper passage of each train onto the block and a second recording device for registering the premature passage of a train onto the block after the engineer has received a warning signal showing the track ahead blocked.

In general it is my object to provide a safety-signal system in which when there is danger ahead, no matter in what form, a closed circuit will be formed and a signal transmitted to the cab of the engine, so as to warn the engineer. With this purpose in view I have illustrated herein the manner in which my system may be adapted for use in connection with different varieties of interfering tracks—such as switches, crossovers, and overlapping parallel tracks—the essential feature of this portion of my invention being to connect the interfering tracks in such a manner that all of the track-sections will form a common block each track of which will transmit a signal showing that it is blocked when a circuit is closed from any one of the tracks of such common block. This feature of my invention I deem of especial importance, especially in its application to sidings or switches and to points where independent roads cross each other.

Another feature of my automatic safety system is the provision, in connection with switches, drawbridges, and other dangerous points, of automatic electric circuit-closers by means of which a circuit will be closed at the track and a signal transmitted to the engineer of an approaching train when any section of the track system is shifted from its normal position—as, for example, when a switch is thrown to open the siding and to close the main line, or when the draw of a bridge is moved from its normal position, or when the road-bed is rendered unsafe by sagging—as, for instance, when there is a washout at a culvert or trestle-work.

In the drawings accompanying and forming part of this specification, Figures 1, 2, and 3 are diagrammatic views of different sections of a double-track railway illustrating my automatic block-signal system applied thereto and also showing in connection therewith various safety features, hereinbefore alluded to, for protecting the several tracks at switches, bridges, &c. Fig. 4 is an enlarged detail plan illustrating, in connection with a portion of the track at the beginning of a block, a track instrument in the form of an electrical recorder for registering the entrance of successive trains into a block. Fig. 5 is a detail illustrating a section of a recording-tape on which such movements of the trains are registered. Fig. 6 is a detail sectional side elevation of a track and vehicle, illustrating a modification of my invention for use in connection with a single-track road, and

will be hereinafter described. Fig. 7 is a sectional plan of the same. Fig. 8 is an enlarged plan view of a portion of the bridge and draw shown in Fig. 1 and illustrates an automatic switch for closing the circuit at the bridge when the draw is open. Fig. 9 is a similar view of the automatic electric switch for the track-switch shown at the left in Fig. 3. Fig. 10 illustrates in side elevation a modification of my invention, showing automatic switches for closing the track-circuits at opposite ends of a track-section at a culvert when there is a washout. Fig. 11 is a sectional plan illustrating a modification of the signaling device upon a train or vehicle as adapted for use in connection with a single-track road, and Fig. 12 is an enlarged detail in elevation, illustrating the signaling device shown in Fig. 2 at the highway-crossing.

Similar characters designate like parts in all the figures of the drawings.

Referring first to Figs. 1, 2, and 3, I have illustrated three sections of a double-track railway embodying my automatic block-signal system, r designating one of the rails of each track, it being in this case a continuous rail or conductor, while r' represents the other rail of the track and is in the nature of a sectional rail, forming insulated blocks. However, it should be understood that the ends of the block-rails of each section may be insulated from each other in any desired manner. At the end of each block-rail r' I have illustrated herein at least one sectional conductor, which may be a short conducting-wire, such as c, located between the rails of the track at one side of the center thereof and preferably in a double-track construction near the outer rail, this sectional conductor being in each instance electrically connected with the block-rail of the block in advance of it, as by means of the connecting-wire 2, shown in said figures. This sectional conductor is in position to permit a traveling contact-maker carried by a vehicle or train moving along the track to make contact therewith and close a circuit to a signaling device on such vehicle to indicate to the engineer at the entrance of each block whether there is danger ahead. This contact-maker is indicated in Fig. 2 by t and is electrically connected with the return-circuit through the rail r by the axles or wheels of the vehicle in the usual manner, the circuit of the vehicle including therein a signaling device, such as i, and preferably a battery, as b.

It will be obvious that when the contact-maker t travels over the sectional conductor c at the end of the block a circuit thereto will be closed from the block in advance of the train, if there is a train on the preceding block or such an obstruction as will close the circuit at the track by bridging the rails r and r'. Hence it will be seen that at the end of each block the engineer of the train will be notified if there is danger ahead by the transmission of a signal to the signaling device in his cab, this device being in the present case a single-stroke bell or gong which will give an audible signal. As hereinbefore stated, I employ in connection with the block-signaling system just described electrical recorders so located and connected as to record, preferably on a moving tape, the passage of each vehicle or train onto a block, these recorders being so constructed as to register the improper or premature entrance of a train into a block after it has received a signal warning it that such block is not clear. One of these recorders should be employed for each block on the road, and each should of course operate independently of the other.

The recorder which I prefer to employ in connection with my system is illustrated, on a large scale, in detail in Fig. 4 and embodies as its essential elements two recording devices operative by electromagnets controlled by the passage of trains, one of these devices operating to record the proper passage of the vehicle and the other the improper passage of a train or running of the engineer past the signal, a recording-tape and feeding means therefor being also contained within the casing within which I deem it advisable to inclose the working parts of this track instrument. The recorder is designated in a general way by R and the casing by C. Within this casing I have illustrated two electromagnets e and e', the former of which is the primary electromagnet and the latter the auxiliary one, they controlling, respectively, primary and auxiliary recording devices, (designated in a general way by m and m'.) The primary electromagnet of each electrical recorder is in this case in circuit with the two rails r and r' of its block, and the circuit will usually include a source of electrical energy, such as a battery 5, located within the casing C. As there is but one break in the circuit to the electromagnet e, and this at the track, it will be obvious that on each passage of a train onto the block with which such recorder is connected the track-rails will be bridged and the circuit at the track closed, thus causing the energization of the electromagnet e and the operation of the recording device m. This recording device comprises as its essential features, in the construction herein shown, an angle-lever, one arm 6 of which carries the armature 7 of the electromagnet, and also a switch 8, the function of which will be hereinafter described, while the other arm of the angle-lever (designated by 9) carries the recording member proper, which in this case is in the nature of a puncturing or perforating member 10, preferably having a sharp point. The usual spring 12 will be employed for retracting the armature of the electromagnet after the latter is deënergized, and this may be controlled by an adjusting device 13.

The construction of the auxiliary recording device m' is substantially similar to that of the primary recording device m, except that the arm 9′ thereof is slightly longer than the

arm 9 and the puncturing member 10′ is set slightly to one side of that shown at 10, so that the two puncturing-points will perforate the tape (shown in Fig. 4) at different points in the width of the tape and also at different points in the length thereof; but it will be noticed that the puncturing members are located in fixed positions relatively to each other, and hence the punctures in the tape will have a corresponding relation. The other parts of the recording device m' (not referred to specifically herein) are designated by the corresponding numerals of the same parts of the recording device m, appropriate prime-marks being employed in connection therewith.

Any suitable means may be employed for limiting the retractive movements of the arms 9 and 9′, a half-link being shown at 14 for this purpose. All of these parts are suitably mounted within the casing C, two supports being shown at 20 and 21′, respectively, on which the several operative parts just described are carried.

The circuit by means of which the running of a train past the warning signal is recorded is not closed directly through the rails r and r' by the wheels and axles of the train, but by the passage of the contact-maker t of the train over a sectional conductor c', corresponding to that shown at c for each block, but located slightly in advance of the latter and preferably at the point of junction of two adjacent blocks. This sectional conductor is connected in this case directly to the electromagnet e' by means of a conductor 25, and the opposite side of the circuit, which is connected to the continuous rail r, has a second break therein controlled by the switch S of the primary electromagnet e'. This will be evident by reference to Fig. 4, in which two contacts 26 and 27 are shown the former of which is connected with the electromagnet e', while the latter is connected with the rail r by means of a conductor 28. When the block is clear, the armature 7 will not be attracted by the electromagnet e, and hence there will be a break in the circuit to the secondary electromagnet e' not only at the track, but also a second break at the contacts 26 and 27; but when the armature 7 is attracted the switch S, spanning the contacts 26 and 27, closes this second break and thereby permits the making of a circuit through battery b by the bridging of the rail r' and the conductor c' in case an engineer should run past the signal with his train while there is another train ahead of him on the block. It will be obvious, therefore, that the secondary recording device cannot be actuated unless the circuit of the primary recording device is closed and that the operation of the secondary recording device is dependent upon the prior operation of the primary recording device, thus assuring the proper operation of the several parts of this track instrument.

From the foregoing description of the several circuits at each track instrument it will be seen that while I employ both sectional track-rails and sectional conducting-wires for each block, yet all of these parts—viz., the rail r' and the wires c and c'—are connected directly or indirectly with one another to form, with the corresponding continuous rail r, a block-circuit controlling the operation of the primary register or recording device directly and controlling conjointly with the primary register the operation of the secondary register or recorder. It will be apparent, of course, that not every portion of the block-circuit is brought into play on each passage of a train onto a block, but some portion of such block-circuit always will be affected by such running of the train. Moreover, although the construction and organization of the sectional conducting-wires and rails shown herein are preferred by me, yet the sizes and positions of these several sectional conductors may be varied so long as the essential feature of a block-circuit embodying sectional conductors is retained.

For the purpose of recording the action of the devices 10 and 10′ I prefer to employ a traveling tape, (designated in a general way by T,) which may be mounted upon a carrier-reel 30 within a casing C and fed forward by means of a feed-reel 31 near the other end of said casing. Between these two reels the tape may be guided by means of a guide-roll 32, over which said tape passes between parallel guides 20′ and 21′, forming parts of the supports 20 and 21. These parallel guides have registering perforations or clearance-spaces in alinement with the respective puncturing devices 10 and 10′ in order to permit the latter to pass freely through the tape when operated.

In the construction shown the only function of the recording device m' is to puncture the tape T; but the recording device m not only serves to record indications on the said tape, but also to feed the latter forward one step at a time on each energization of the electromagnet e. The connections shown herein for effecting this feed movement comprise a ratchet-wheel 35, secured to the spindle 36 of the feed-wheel 31, an arm 37, loosely mounted on said spindle and carrying at its end a feed-pawl 38, and a connecting-rod 39, joining said arm and the arm 6, it being obvious that the feed movement does not take place until the electromagnet e is deënergized and the arm 6 retracted by the spring 12. A spring-pressed stop-pawl, such as 40, may be employed for holding the ratchet-wheel against return movement.

While I have described the actuation of the recording-tape as being accomplished in this instance by connections from the armature of the electromagnet e, I do not limit myself to the construction illustrated, but may make use of any feeding means or clockwork for advancing said tape. It will be clear now that if the engineer runs onto a block of the rail-

way prematurely three circuits will be closed before he passes by the entrance to the block, the first of these being the circuit closed by the bridging of the track-rails by the train ahead of him, the second being the circuit closed by the contact-maker *t* of his own train traveling over the sectional conductor *c*, which will of course ring the gong *i* and warn him that the section in advance of him is blocked, while the third is the circuit completed by the passage of the contact-maker *t* of his own train over the sectional conductor *c'*, all of which will be clear by reference to the drawings.

In the construction shown herein it will be noticed that each train or vehicle carries thereon not only a signal device or bell, but also a battery *b*, which constitutes a source of energy for operating said bell to receive the warning signal and also to energize the electromagnet of the auxiliary recording device to operate the latter.

I have hereinbefore referred to that feature of my invention which has for its object the protection of the blocks of a single or double track line from collision with vehicles moving or standing upon interfering track-sections, and in Figs. 1, 2, and 3 I have shown the application of this feature of the invention for protecting several varieties of interfering tracks.

In Fig. 1 the tracks of the double-track railway overlap and run parallel with each other across a bridge, (designated in a general way by B,) the two sets of rails *r* and *r'* being connected, as shown in Fig. 1, by bond-wires 45 in such a manner that the two sections of the two tracks at this point are electrically connected to form parts of a common block the circuit of which is normally open at the track and will be closed by the presence of a vehicle on either track.

It will be obvious that if a train is on one of these tracks of the bridge such fact will be signaled to an approaching train or trains on adjacent blocks, whether such trains be on the same track or different tracks, thus completely protecting all approaches to the bridge.

In Fig. 2 I have illustrated the application of this feature of the invention to an intersection or crossover at the juncture of two double-track roads. In this case all of the rails of the different tracks at the juncture are preferably insulated from one another, as indicated at 46, and the adjacent blocks of all of the tracks are electrically connected with one another to form a common block. The bond-wires which I prefer to employ for this purpose are illustrated at 47, 47', 48, 48', 49, 49', 50, and 50', the conductor 47' being connected to conductors 49' and 50', the conductor 47 to the conductors 49 and 50, the conductor 48 to conductors 49 and 50, and the conductor 48' to the conductors 49' and 50'. By means of these cross connections I am enabled to electrically connect all of the blocks adjacent to the juncture with one another in such a manner as to form a normally open circuit for all of said blocks; but when a train is on any one of the blocks adjacent to this junction a circuit will be closed which will include all of the eight adjacent blocks and the engineers of all trains approaching the crossing from the next adjacent block in any direction will be warned by their signal-bells *i* of the presence of the train ahead.

In Fig. 3 I have illustrated the application of this feature to a single track having a siding. As is well known, cars are sometimes left standing on the side track in such positions that one of the ends thereof projects over or too close to the main track of the road and this causes what are known as "side-wiping" collisions when a train passes by on the main track. In order to prevent this, the siding, the rails of which are designated by *s* and *s'*, is divided into sections in substantially the same manner as is the main track in forming the block-sections, the end sections of this siding being of such length that if the end of a car is in position to interfere with the main track the inner rail of the siding and the end section of the outer rail will be bridged by the wheels and axles of the car.

It will be evident that if a car is on the central section of the siding there will be no danger of collision with a train on the main line. In order to warn the engineer of an approaching train that a car on a siding projects over the main track, the rails *r* and *r'* of the main track are divided into insulated sections at the points of intersection with the siding, as shown in Fig. 3, and the inner sections of these rails are connected with adjacent blocks by means of bond-wires 150, 150', 151, and 151' to form continuous conductors, which will be included in a common block. The inner rail *s* of the siding is connected with the rail *r* of the main track by a bond-wire 52, and the end sections of the outer rail *s'* of the siding and the adjacent block-rails of the main track are also bonded by means of wires 53 and 53', so that all of the interfering rails of the two tracks are connected in a common block. As cars standing or moving on the central section of the siding will not interfere with the operation of the main line, it will be apparent that it need not be included in said block; but if a car is on one of the end sections of the siding the circuit of the common block will be closed and the connections illustrated will permit the transmission of a signal to the engineer of a train on the adjacent block at either end of the switch.

Reference has been made hereinbefore to the employment, in connection with my block-signal system, of safety devices in the form of automatic electric switches or circuit-closers for closing the circuit at the track on the shifting of a track-section from its normal position, the switches being used for the purpose of closing the circuits of approaching trains to warn the engineers and prevent derailment

of the train and similar accidents by such shifting of the track.

In Fig. 8 I have illustrated in detail the device that I prefer to employ in connection with the drawbridge shown in Fig. 1. In this case the draw is a horizontally-swinging one and carries a boss 61, with which a resilient contact-arm 60 on the fixed portion of the bridge is adapted to coöperate. The contact-arm 60 has a boss 60′, corresponding to that shown at 61 and normally engaging therewith for the purpose of holding the switch-arm off from the contact 62, through which it is adapted to close a circuit at the tracks on the swinging of the draw away from its normal position. The contact 62 is connected with a conductor 63, which in turn is secured to the outer or block rails r' of the two tracks crossing the bridge. In a similar manner the switch-arm 60 is electrically connected to a conductor 64, joining the inner or continuous rails r of these tracks. It will be clear now that on the opening of the draw the switch-arm will be released and will close the circuit at both tracks, thus assuring the transmission of a signal to the engineer of a train approaching on either track. The sections of each rail crossing the bridge are discontinuous and will be electrically connected in some suitable manner when the draw is closed, a yielding switch-arm 65 and contact 66 being shown herein for making the proper connections at such time.

It will be obvious that the devices employed at the opposite end of the draw are substantially the same as those shown in Fig. 8.

In Fig. 9 I have illustrated the manner in which the main line may be protected when the siding is open, this view being a detail of the device illustrated at the left-hand end of the siding shown in Fig. 3.

Any suitable means may be employed for throwing the movable rail at Fig. 9; but I have illustrated herein a switch-rod 67, connected to said rail and also having secured thereto at the outer end thereof a link 68, which in turn is pivotally connected to a crank-arm 69, secured to a shaft 70, journaled in suitable bearings and having fixed thereto an operating-lever 71. In the position shown the link 68 and crank 69 are on the dead-center, and they will be also on the dead-center for the opposite extreme position.

A yielding contact-arm 72 is secured to the switch-arm 67 and moves therewith and is adapted to be carried on to a fixed contact 73 when the movable rails are shifted to open the siding. The fixed contact is connected by a conductor 74 to the bond-wire 151, and the circuit-closing contact-arm is similarly connected by means of a conductor 75 to the sectional rail of the next adjacent block, so that on the opening of the siding a circuit at the track will be closed, which will permit the warning of the engineer in the cab of an approaching train in the manner hereinbefore specified. As the switch-throwing and electrical-switch devices at the opposite end of the siding (shown in Fig. 3) are substantially similar to those just described, a detailed description of the same will not be necessary.

In Fig. 10 I have illustrated the manner in which a circuit may be closed at opposite ends of a track-section at a culvert in case of a washout. In this view two counterweighted switch-arms are shown at 80 and 80′, respectively, these preferably being pivoted to the ties and connected by means of a wire 81, on which weights are strung in any desired manner. In this case the weights 83 are carried by pointed rods 84, having eyes at their upper ends, through which the wire 81 passes, the pointed ends of the rods being driven into the earth to maintain the weight and rod in their normal position. The switch-arms 80 and 80′ coöperate with fixed contacts 82 and 82′, the fixed contacts being in electrical connection with one of the track-rails and the switch-arms with the other. It will be obvious now in case this section of the track sinks, by reason of a washout, the weights 83 will cause the making of the track-circuits at opposite ends of said section, and thus permit the transmission of the usual warning to an approaching train, the tension on the wire due to the pull of the weights when the track sinks being sufficient to operate the circuit-closers 80 and 80′.

In Figs. 6 and 7 I have illustrated a modification of my invention which may be employed in connection with a single-track road. In these views two sectional conductors c and c'' are shown, and these are connected alternately with the block-rails at the beginning and at the end of each block, they being located at opposite sides of the center of the track, so as to coöperate, respectively, with two contact-makers t and t', carried by a vehicle movable along the track. It will be clear by reference to these views that the contact-maker t will make traveling contact with the sectional conductor c and receive indications from the block in advance of it when the vehicle is moving in the direction indicated by the arrow, while if the train is moving in the opposite direction the contact-maker t' will make traveling contact with conductor c''. These contact-makers carry automatic circuit-closers, (designated, respectively, by 85 and 85′,) which are positioned so as to coöperate with fixed contacts 86 and 86′ to close a circuit to the signaling device or bell i alternately, according to the direction of movement of the train. When the train is moving toward the left, as seen in Fig. 6, the switch-arm 85 when on conductor c is held against the fixed contact 86 to close the circuit of the bell through conductor 87, while when the train moves in the opposite direction the switch-arm 85′ is brought into engagement with contact 86′ to close the circuit

through the conductor 87′. It will be noticed that when either of these switch-arms closes the circuit the contact-maker of the other in passing over the sectional conductors at the other side of the track will hold the switch-arm, which it carries away from its coöperating contact-terminal, and prevent the closing of the circuit. Both contact-makers when not in engagement with the sectional conductors will, in the construction shown, be freely suspended, and both circuits through the bell will be broken.

In Fig. 11 I have illustrated a modification of the invention in which the contact-makers *t* and *t′* are connected directly with a pair of signaling devices *i* and *i′*, the return conductors of which are preferably connected to an axle of one of the trucks, separate batteries *b b′* being employed for these bells, which should of course be of the "single-stroke" type and preferably will have different tones, so that the engineer can distinguish which bell is struck when he receives a warning-signal. Two bells are employed for the purpose of enabling the engineer to receive indications not only from the block in advance of him as his train goes on to such block, but also from the block behind him as he goes off from such block, one giving a signal from the block ahead and the other a signal from the block in the rear.

It will be apparent that both in the construction shown in Figs. 6 and 7 and in that shown in Fig. 11 the contact-makers which are located respectively in advance of the forward axle of the pilot-truck and in the rear of the rear axle of the tender are so positioned as to permit them to operate properly, whether the engine is running forward or backward on a single track.

In Fig. 12 I have illustrated in detail the construction of the device illustrated diagrammatically in Fig. 2 for giving warning of the approach of a train toward a highway or grade crossing. This device will preferably be mounted upon a suitable mast and controlled by the circuit from a long sectional conductor *c‴*, with which the contact-maker *t* is adapted to make traveling contact.

In the construction shown a conductor 90 connects a solenoid S with the sectional conductor *c‴*, while the wire 91 connects the other terminal of the solenoid with the block-rail *r′*. The core 92 of the solenoid is in this construction connected to one arm 93 of an angle-lever pivotally mounted in a suitable casing S′ on top of the mast M, the other arm 93′ having at its end a switch member 94, adapted to bridge a pair of contacts 95 and 95′, controlling a local circuit including a battery *b″* and a bell *i″*. At the outer end thereof the arm 93 carries a segmental gear 96, which meshes with a corresponding segment 97, secured to a double semaphore-arm or stop-board 98, which when the solenoid is energized will be thrown to a horizontal position to indicate danger, and when the solenoid is deënergized will assume the position shown in Fig. 12.

In order to provide for night-work, I have illustrated a bracket 99, adapted to carry a pair of lamps L and L′, the former of which has a red light and the latter a white light. These lanterns are so positioned that the two blades of the double semaphore-arm 98 will be at opposite sides of the lanterns. When the semaphore is in its clear position, it will hide the red light and show the white light, while in the danger or horizontal position said semaphore will hide the white light and show the red light. The bell *i″* (illustrated in this figure) is a vibratory one adapted to ring continuously when the circuit thereto is closed.

The operation of the system hereinbefore described will be obvious. Each train will on entering a block close a track-circuit by the travel of its contact-maker over the proper sectional conductor *c*, and a circuit will be completed from the battery on the train, which will cause the sounding of a stroke on the bell if there is another train on the block in advance of it, and the engineer will be warned of the presence of such preceding train. Immediately on the passage of each train onto a block a circuit will be closed by the bridging of the track-rails *r* and *r′*, the circuit being from battery 5 to the electromagnet *e*, conductor 23 to conductor 28, to rail *r*, to rail *r′*, and back by way of conductor 24 to battery. The energization of the electromagnet *e* causes the operation of the recording device *m* and the puncturing of the tape T to indicate the passage of the train. If the engineer after receiving warning of the presence of a train on the block in advance of him persists in running onto such block, a circuit will be closed from battery *b* to the contact-maker *t*, sectional conductor *c*, conductor 25, electromagnet *e′*, conductor 28′, contacts 26 and 27, (which are then bridged by the switch 8,) conductor 28, rail *r*, and axles of the vehicle, back through the electromagnet of the bell *i* to the battery, the energization of the electromagnet *e′* causing the making of a record on the tape T at one side of that made by the recording device *m*.

The operation of the various safety devices for protecting the block system has been fully described herein. In connection with these safety devices, however, it should be stated that when a warning has been received by the engineer of danger ahead by closure of the circuit at the track the nature of the danger may be indicated, if desired, by varying the number of breaks in the circuit. In Fig. 2, for instance, the engineer receives at the entrance to each block a warning-signal of two strokes by reason of the travel of a contact-maker over the successive sectional conductors *c* and *c′*, while at the approach to the highway-crossing he receives a signal made up of three strokes of the bell, due to the travel of the contact-maker over sectional conduc-

tors *c*, *c'*, and *c'''*. Obviously this method may be applied to the approaches to bridges, railroad-crossings, &c., in the same manner to indicate the nature of the danger ahead.

Having described my invention, I claim—

1. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of a vehicle movable along said track; a primary electrical register controlled by a block-circuit; and a separately-operative secondary electrical register controlled conjointly by the primary register and a block-circuit.

2. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of vehicles movable along said track; a primary electrical register for each block and controlled by the block-circuit; and a separately-operative secondary electrical register for each block and controlled conjointly by the primary register and the block-circuit.

3. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of vehicles movable along said track; a primary electrical recorder for each block and controlled by the block-circuit; and a separately-operative secondary electrical recorder for each block and controlled conjointly by the primary recorder and the block-circuit.

4. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of vehicles movable along said track, and electrical recorders one for each block and each embodying separately-operative primary and secondary recording devices controlled by the block-circuit, each secondary recording device being controlled also by its respective primary recording device.

5. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of vehicles movable along said track; and electrical recorders, one for each block, and each embodying a primary recording device in a circuit controlled by said block, and a separately-operative secondary recording device in another circuit controlled conjointly by the primary recording device and by said block.

6. In an automatic electric block-signal system, the combination, with a track having a sectional rail forming insulated blocks, of sectional conductors one at the beginning of each block; vehicles movable along said track; contact-makers carried by said vehicles and adapted to make traveling contact with said sectional conductors; and electrical recorders one for each block and each embodying a primary recording device in circuit with the track-rails, an auxiliary recording device in circuit with the sectional conductor and with one of said rails, and an automatic circuit-closer controlling the circuit of the auxiliary recording device and controlled by the primary recording device.

7. In an automatic electric block-signal system, the combination, with a track having a sectional rail forming insulated blocks, of pairs of sectional conductors at the beginning of each block one connected with the block-rail and the other with an auxiliary recording device; vehicles movable along said track; contact-makers carried by said vehicles and adapted to make traveling contact with said sectional conductors; a signaling device on each vehicle and in circuit with its contact-maker and with the track-rails; and electrical recorders one for each block and each embodying a primary recording device in circuit with the track-rails, an auxiliary recording device in circuit with one of the sectional conductors and with one of said rails, and an automatic circuit-closer controlling the circuit of the auxiliary recording device and controlled by the primary device.

8. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of vehicles movable along said track; and electrical recorders, one for each block, and each embodying a primary recording device in a circuit controlled by said block, a separately-operative secondary recording device in another circuit controlled conjointly by the primary recording device and by such block, a recording-tape, and tape-feeding means controlled by one of said recording devices.

9. In an automatic electric block-signal system, the combination, with a track having a sectional conductor forming insulated blocks, of vehicles movable along said track; and electrical recorders, one for each block, and each embodying a primary and a secondary puncturing recording device disposed in fixed positions longitudinally of the tape to puncture said tape in corresponding positions, the primary recording device being located in a circuit controlled by such block, and the secondary recording device in another circuit controlled conjointly by the primary recording device and by such block, a recording-tape, and tape-feeding means controlled by one of said recording devices.

10. In an automatic electric block-signal system, the combination, with a pair of tracks running in the same direction, side by side, and crossing each other, one having a sectional rail forming insulated blocks and the other having an interfering track-section electrically connected with a section of the first track to form therewith a common block, of sectional conductors connected with the block-rails of the first track, one at the beginning of each block; vehicles movable along said tracks; contact-makers carried by said vehicles, respectively, and adapted to make traveling contact with said sectional conductors;

and signaling devices on said vehicles, respectively, and in circuit with said respective contact-makers and with the track-rails.

11. In an automatic electric block-signal system, the combination, with a pair of tracks running in the same direction, side by side, and crossing each other, each having a sectional rail forming insulated blocks and both having interfering track-sections electrically connected to form at such a point a common block, of sectional conductors connected with the block-rails of such tracks, one at the beginning of each block; vehicles movable along said tracks; contact-makers carried by said vehicles, respectively, and adapted to make traveling contact with said sectional conductors; and signaling devices on said vehicles, respectively, and in circuit with said respective contact-makers and with the track-rails.

12. In an automatic electric block-signal system, the combination, with a track having a sectional rail forming insulated blocks, of sectional conductors at opposite sides of the center of the track and connected with said sectional rail alternately at the beginning and at the end of each block; a vehicle movable along said track; a pair of contact-makers carried by said vehicle and adapted to make traveling contact, respectively, with said respective sectional conductors; a pair of automatic circuit-closers carried and controlled, respectively, by said respective contact-makers and operative alternately in opposite directions from their respective open positions to close their respective circuits in accordance with the direction of movement of the vehicle; and a pair of signaling devices on said vehicle and in circuit with the track-rails and controlled by said circuit-closers.

LOUIS C. WERNER.

Witnesses:
FRED. J. DOLE,
F. N. CHASE.