(No Model.) 3 Sheets—Sheet 1.

T. B. DIXON.

ELECTRICAL RAILWAY SIGNALING SYSTEM.

No. 543,592. Patented July 30, 1895.

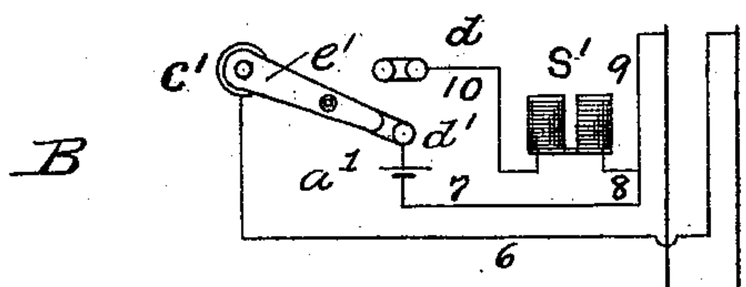
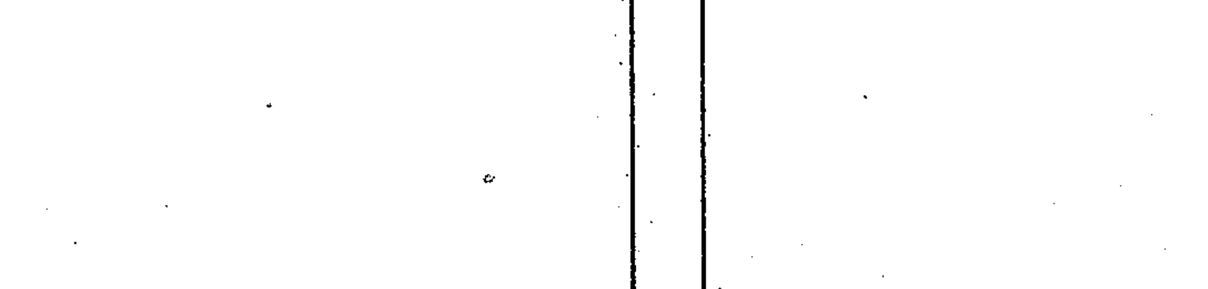


Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

T. B. DIXON.

ELECTRICAL RAILWAY SIGNALING SYSTEM.

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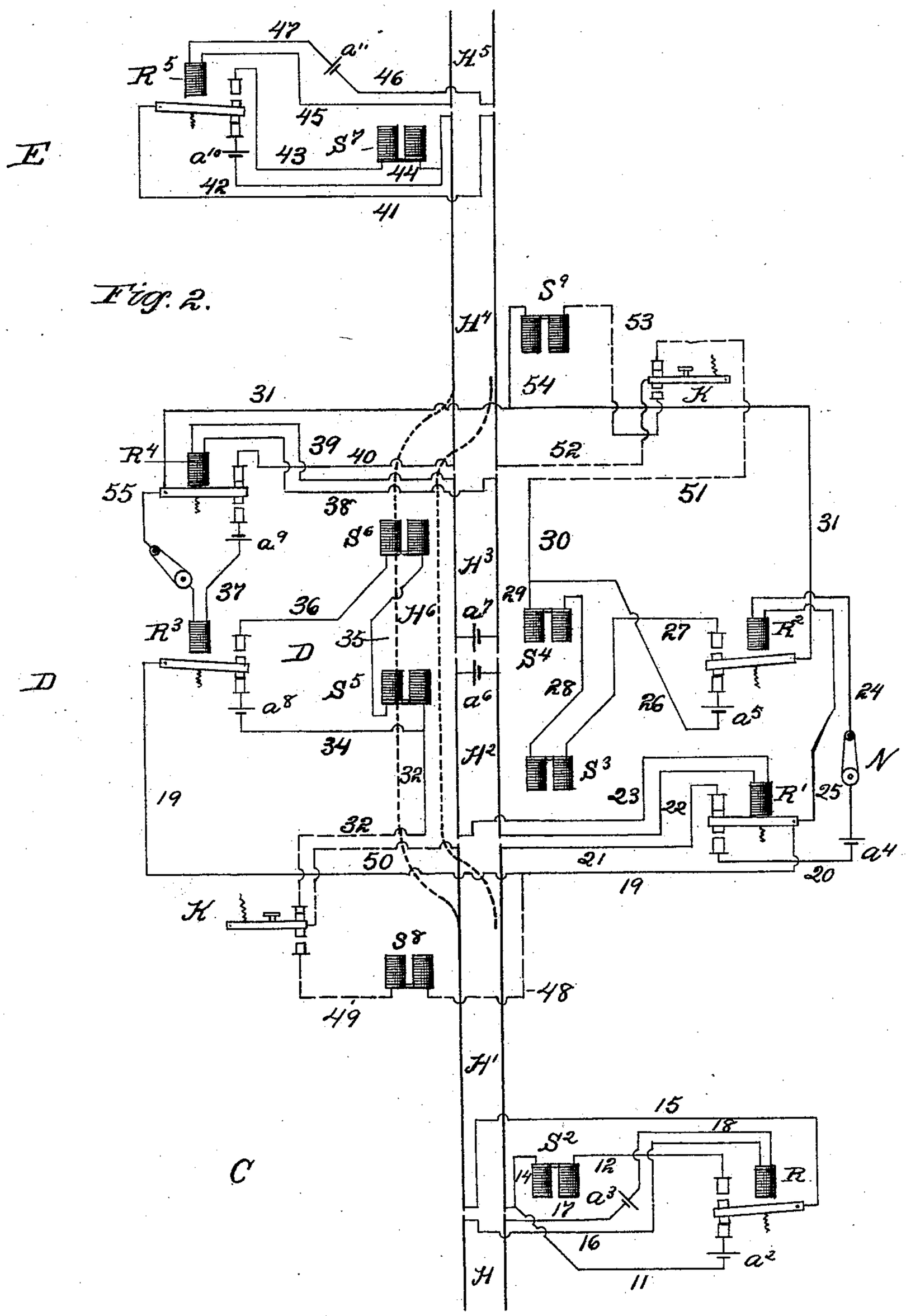
Fig. 2.



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ELECTRICAL RAILWAY SIGNALING SYSTEM.

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Fig. 3.

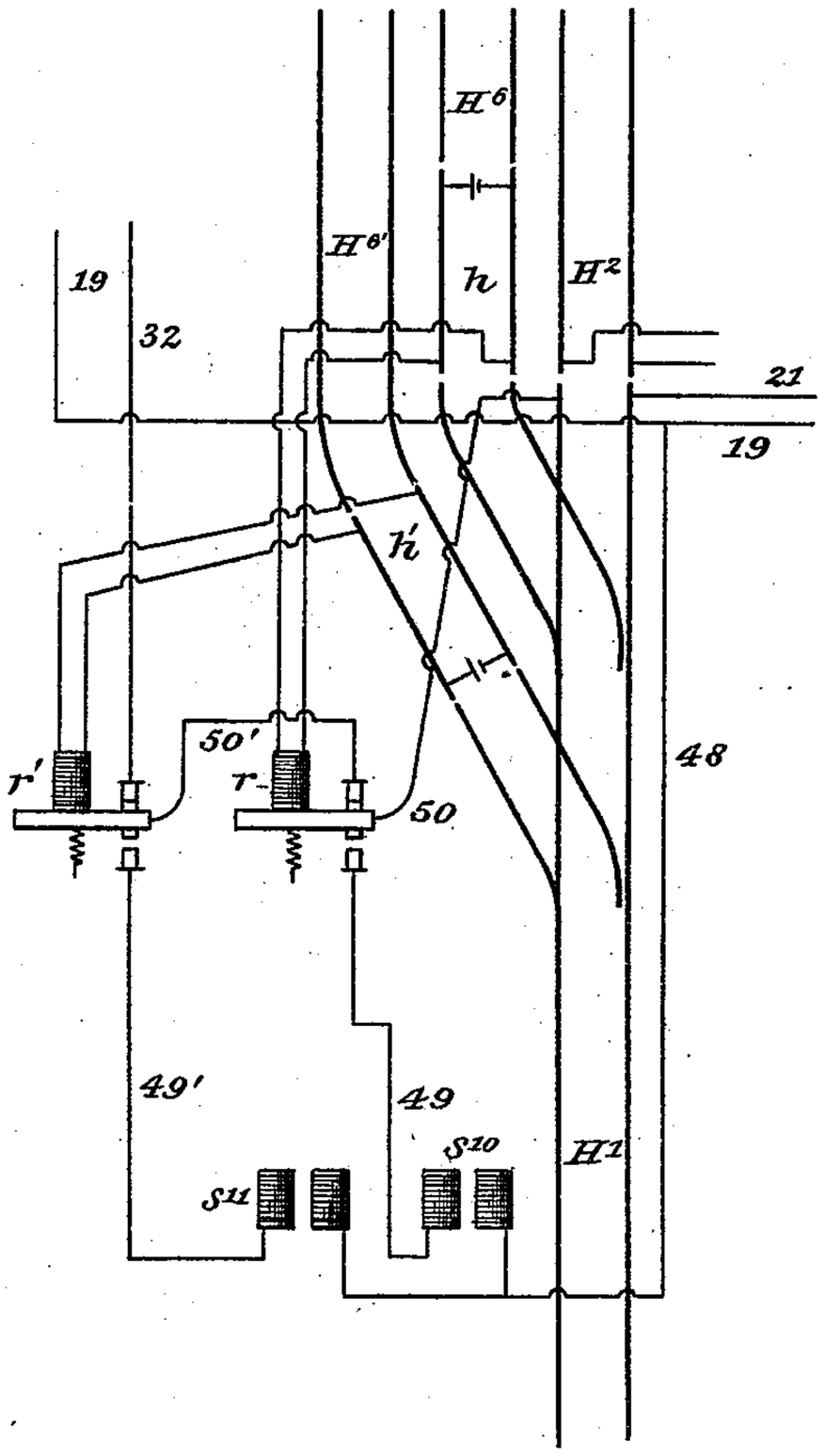
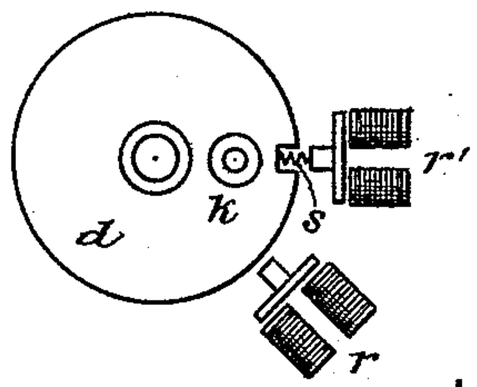


Fig. 4.



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UNITED STATES PATENT OFFICE.

THOMAS BULLITT DIXON, OF HENDERSON, KENTUCKY.

ELECTRICAL RAILWAY SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 543,592, dated July 30, 1895.

Application filed October 5, 1893. Serial No. 487,209. (No model.)

To all whom it may concern:

Be it known that I, THOMAS BULLITT DIXON, a citizen of the United States, and a resident of Henderson, in the county of Henderson and State of Kentucky, have invented certain new and useful Improvements in Electrical Railway Signaling Systems, of which the following is a specification.

My invention relates, generally, 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 customarily takes place in both directions; and my invention consists in the novel arrangement of signals and circuits, as is more fully hereinafter described.

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 moving in the same or opposite directions; second, to provide a system of signals which may be capable of manual operation at points where attendants may be stationed for that purpose, suitable devices being employed to make it impossible for any attendant to clear the signal at either end of the block so long as a train is within that block, and to so arrange this system that it may be arranged to operate automatically at points where no attendants are stationed; third, to provide a signaling system in which the safety factor is as high as possible, all of the apparatus being so arranged that the failure of any part will cause the signals affected thereby to remain at "danger," if at "danger," or to go to "danger" if at "safety;" fourth, to provide means for setting to "danger" the signals of a block, when a train is within that block, independent of the condition of the instruments which operate the signal-circuit of that block; fifth, to provide a system which shall be simple and as inexpensive in construction as possible, certain in action, not liable to derangement, and economical in use of battery power. These objects are attained in the system 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 the simplest form of my system, and comprises a block with suitable signals and circuits therefor, the signals being arranged to be operated manually. Fig. 2 shows two adjacent blocks with suitable signals and circuits therefor, the signals being arranged to be operated automatically. There is likewise shown a side track with suitable signals and circuits governing traffic thereon. Fig. 3 shows an arrangement of signals and circuits for a situation where two side tracks communicate with the main track at points in close proximity to each other. Fig. 4 shows an interlocking device which may be used to regulate the traffic on sidings at a situation similar to that shown in Fig. 3.

In my system I divide the railway-track into blocks, in each of which only one train is to be allowed at a time. Each line of rails in the block is in contact electrically, but the two lines of rails constituting the track are insulated one from the other in any suitable and customary manner, and the rails of each block are insulated from the rails of the adjacent blocks. At the entrance of each block is placed one or more signals controlling the admission of trains to that block. These signals are represented in the drawings by electromagnets placed close beside and parallel to the track, and the signals are to be understood to face in the direction of the open or polar ends of the electromagnets.

I do not confine myself to the use of any particular type of signal, but may use any signal capable of being controlled by an electromagnet, though the signal itself may be operated by electric, pneumatic, or hydraulic power, or by weights.

The electromagnets shown in the drawings as representing the signals themselves may be understood to be the controlling-magnets of such signals. It is to be understood, however, that the signal, of whatever class, is so controlled by its electromagnet that the signal is at "danger" when there is no current flowing through the coils of its controlling-electromagnet and is at "safety" when current is flowing through the coils of that magnet. The reverse might indeed be true, but I consider the above arrangement preferable and have arranged the electric circuits with that end in view.

In my system the normal position of all signals is "danger," and the signal at the entrance of a block must be set to "safety" through the operation of a switch or relay by which the signal-circuit passing through that signal is completed. After the train has entered the block this signal can and should be returned to "danger" through the reverse operation of this switch or relay, thus breaking the circuit through the signal; but I provide means for automatically returning said signal to the "danger" position in any case.

Referring now to the drawings, and considering first Fig. 1, which illustrates the simplest form of the circuits, being arranged solely for manual operation, A B is a block of a single-track railway, A and B being block-stations. S and S′ are the signals at the ends of the block, governing the entrance of trains thereto. *c* and *c′* are two-point switches, and *a* and *a′* are batteries for operating the signals, and, as will be seen when the circuits are traced, each signal is operated by the current from the battery at the opposite end of the block. The switches are shown in their normal position. Tracing now the circuits of the diagram, and beginning at the positive pole of battery *a* at station A, the circuit goes to the contact-point *b′* of switch *c*, thence, if the circuit is complete at that switch, through the switch-lever *e* and through the wire 1 to the left-hand rail, thence through the rail to station B, through wires 9 and 7 and through battery *a′* to contact-point *d′* of switch *c′*, through the switch-lever *e′* and through wire 6 to the right-hand rail, thence through the rail to station A, and thence through wires 4 and 2 to the negative pole of battery *a*. At station A there is a branch circuit formed by wires 3 and 5, which passes through signal S and terminates in the contact-point *b* of switch *c*. At station B there is a similar branch circuit formed by wires 8 and 10, which passes through signal S′ and terminates in contact-point *d* of switch *c′*.

It will be seen that normally the circuit of batteries *a* and *a′* is complete through the switches *c* and *c′* and that the signals are normally out of circuit, and therefore, since there is no current flowing through them, are at "danger."

To admit a train to the block at station A the signal-operator there moves the lever *e* of the switch *c* so as to break contact with contact-point *b′* and make contact with contact-point *b*. The effect of this is to break the circuit of battery *a* and to divert the current of battery *a′* through signal S. Signal S is thus set to "safety," so that the train may enter the block. When the first cars of the train have entered the block the operator may return the switch-lever to its former position in contact with contact-point *b′*, thus cutting out signal S again; but, independent of the operation of the switch-lever, other and separate means are provided for returning signal S to "danger" immediately upon the entrance of the train into the block. As before described, the two track-rails form portions of the circuit of battery *a′*. When therefore the wheels of a car are upon these rails the battery is short-circuited through the wheels and axles of this car, so that current from battery *a′* no longer passes through the signal, which must therefore go to "danger," and it is impossible to set this signal to "safety" again while a car of the train remains upon the block. In the same way, when it is desired to admit a train to the block at station B, the operator there moves the lever *e′* of switch *c′* into contact with contact-point *d*, thereby cutting out battery *a′* and diverting the current of battery *a* through signal S′, provided the circuit of battery *a* is complete at switch *c* and provided there are no cars already upon the block, for if the circuit of battery *a* is not complete at switch *c*—that is, if the operator at A has already moved that switch to set signal S to "safety"—then the moving of the lever *e′* from its normal position not only cannot complete a circuit through signal S′, but it breaks the circuit of battery *a′* and therefore returns signal S to "danger," and neither signal can be set to "safety" until one of the operators returns his switch to normal; and if there is a car already upon the block A B, then both batteries will be short-circuited through the wheels and axles of this car and no current can flow through either signal. It will be seen, therefore, that while an operator at either block-station may admit a train to the block at his own end thereof, provided the block is clear and the switch at the other end of the block is in normal position, no movement of his switch can set his signal to "safety" if there is a car already on the block or if the operator at the other end of the block has already set his signal to "safety" to admit a train to the block from that end, and if both operators endeavor to set their signals to "safety" at the same time both batteries are cut out and neither signal is moved from the "danger" position. Thus all conditions required for the safe management of a train within the block are complied with and it is impossible that two trains should be in the same block at the same time, unless the indications of the signals are neglected.

The circuits of Fig. 1 are arranged for manual operation. My system is equally capable of automatic operation, and in Fig. 2 I have shown circuits arranged for automatic operation. This figure shows two consecutive blocks with the devices adopted for making impossible the clearing of the signals in rear of a train until the train has passed well into the block in front. There is likewise shown a siding with signal arrangements therefor. The siding-rails and the additional wires necessitated by the siding are shown in dotted lines.

C, D, and E are block-signal stations, and, as shown in the drawings, C and E are terminal stations beyond which traffic governed by

block-signals is not supposed to extend, while D is an intermediate station. There may be any number of other stations similar to D intermediate between stations C and E. The signal-circuits are in general the same as in Fig. 1, except for the modifications required by the introduction of the siding at station D and for the additional local circuits required for the automatic operation of the signals. The double-point switches of Fig. 1 are replaced by double-point relays, which control the signal-circuits in a similar manner, and these relays are operated by local circuits connected to short insulated sections of track placed intermediate between the insulated sections of the main blocks. When a car is on one of these insulated sections of track, the local battery of that track-section is short-circuited and the relay is operated. These relays and insulated sections of track, with their circuits, correspond to track-instruments, and, indeed, track-instruments might be used in place thereof; but I believe the arrangement here shown to be preferable to any track-instrument, as it is simpler, less expensive, and less liable to derangement.

The sections of track forming the blocks are insulated, as described for Fig. 1. S^2 to S^7, inclusive, are block-signals, S^3 and S^6 being caution or distant signals, while the others are absolute danger-signals. S^4 and S^5 are the danger or home signals, corresponding respectively to distant or caution signals S^3 and S^6. S^8 and S^9 are siding-signals governing the movement of a train on the siding and are not heeded by trains on the main track. N and N′ are hand circuit-breakers, and K and K′ are keys, similar to the ordinary Morse telegraph keys, except that they have both upper and lower contact-points which are electrically connected. These circuit-breakers and keys are used principally in the operation of the siding and need not be considered in the discussion of the operation of the main track signals and circuits.

The signal-circuit of block C D is as follows: Starting at the positive pole of battery a^2 the circuit goes through the lower contact or relay R, if that contact is complete, and through wire 15 to the left-hand rail of the track-section H′, which is the main section of track forming the block C D, and through that rail to station D, thence through wire 50, the contact-points of key K, and wire 32 to battery a^8, thence through the lower contact of relay R^3, if that contact be closed, through wire 19, the upper contact of relay R′, if that contact be closed, and through wire 21 to the right-hand rail of section H′, through the rail to station C, and thence through wire 11 to the negative pole of battery a^2. As in Fig. 1, there are branch circuits for signals S^2 and S^5, which terminate in the upper contact-points of relays R and R^3 respectively, and these branch circuits are precisely the same as those of Fig. 1, except that at station D the circuit of signal S^5 likewise passes through signal S^6, which is its corresponding distant or caution signal, so that these two signals are in series, and must always correspond in indications.

The relay R is controlled by a local circuit formed by wires 16, 17, and 18, which passes through the coils of the relay and is connected to the rails of the insulated track-section H. The battery for this circuit is a^3. When a car is on this section H the circuit of battery a^3 is completed through the wheels and axles of the car and the armature of the relay R is raised.

The circuits of block D E correspond to those of block C D.

To the rails at one end of the insulated section of track H^2 are connected the poles of a battery a^6. To the rails of this insulated section, at the other end, are connected wires 22 and 23, which, together with the rails, form a circuit from battery a^6, which passes through the magnet-coils of relay R′. This circuit is normally complete; but when a car enters this insulated section the current of the battery is short-circuited through the wheels and axles of this car, so that no current passes through the coils of relay R′. This causes the armature of this relay to fall, thus completing a circuit from battery a^4 through the lower contact of relay R′, thereby through wires 25 and 24, key N, and the coils of relay R^2, and raising the armature of relay R^2, and likewise breaking the circuit of battery a^8, so that even after the passage of the last car of the train out of the section H′ it is not possible for a train on section H to set signal S^2 to "safety." The effect of the raising of the armature of relay R^2 is to break the circuit of battery a^5 at station D and to divert the current of battery a^{10} at station E through signals S^3 and S^4, provided, of course, this battery a^{10} is not short-circuited through the presence of a train in the block D E and provided the circuit of battery a^{10} is not broken at relay R^5 through the presence of a train on the insulated section H^5 at station E; but, supposing block D E and track-section H^5 to be clear, the effect of the entrance of a car upon the track-section H^2 is to set to "safety" signals S^3 and S^4, so that the train may pass on into track-section H^3. The insulated track-section H^3 has a battery a^7 and a circuit therefor corresponding to that of section H^2 and passing through the coils of relay R^4. When a car of a train enters section H^3 this battery a^7 is short-circuited, so that no current flows through the coils of relay R^4. The armature of this relay therefore falls, completing a circuit of battery a^9 through the coils of relay R^3, wires 37 and 55, and key n', thereby causing the armature of relay R^3 to rise and breaking the circuit of battery a^{10} at station E.

When the rear of the train passes off from section H^2, the armature of relay R′ is raised, thus completing the line-circuit of block C D. The armature of relay R^3 now being up, as

above described, battery a^8 is out of the line-circuit. If, therefore, a train should pass upon track-section H, signal S^2 cannot go to "safety" and the train on H cannot pass into the block C D. The block C D is still closed to trains desiring to enter at C, therefore. If no train is upon the track-section H, then when the rear of the first train has passed onto track-section H^3 and off from section H^2 the completion of the line-circuit of block C D will cause the current from battery a^2 to set to "safety" signals S^5 and S^6, so that the train may again enter the block C D by backing; but the moment that a train enters track-section H, battery a^2 is cut out of the line-circuit and signals S^5 and S^6 are set to "danger" and the train on section H^3 will be warned not to enter the block C D.

The breaking of the circuit of battery a^{10}, owing to the rise of the armature of relay R^4, returns signals S^3 and S^4 to "danger," thereby protecting the rear of the train on track-section H^3 after it shall have passed off from that section and into the main portion of the block D E. The raising of the armature of relay R', which occurred when the last car of the train passed off from section H^2, restored battery a^5 to the line-circuit of block D E.

When the last car of the train has passed off from section H^3 the armature of relay R^4 rises and the armature of relay R^3 falls. Signals S^5 and S^6 are thus returned to "danger" and the circuit of battery a^8 is completed, so that a train upon the insulated track-section H will now cause signal S^2 to go to "safety." The block C D is therefore completely clear as soon as the last car of the train at D has left track-section H^3.

The circuits of station E are the same as those of station C and need no description.

The function of the cautionary signals S^3 and S^6 is to insure that no train shall run by the corresponding danger-signals through lack of timely warning. Ordinarily a train from station C will enter the track-section H^2 at full speed. If the block D E is clear and if no train be upon the track-section H^5, the signal S^3 and the corresponding home-signal S^4 as well should go to "safety" when the train enters this section H^2 through the raising of the armatures of relays R' and R^2. If, therefore, this signal S^3 does not go at once to "safety," the engineer of the advancing train is warned that the block D E is not clear, and he will then bring his train under control and stop it at the danger-signal S^4, which he will not pass until it has gone to "safety."

Signals S^8 and S^9 are signals controlling the passage of trains from the side track at station D onto the main track, and are not regarded by trains passing on the main track. The circuits are so arranged that a train on the side track cannot pass out onto the main line if a train is already within the block which this train on the side track desires to enter. What is said herein of one signal and of its circuits applies likewise to the other signals and circuits, so that but one need be mentioned.

Signal S^8 is by its circuits electrically interlocked with signals S^5 and S^6 and battery a^8, so that when the key K is depressed signals S^5 and S^6 and battery a^8 are cut out of circuit, while signal S^8 is cut into circuit with battery a^2 at station C through wires 48, 49, and 50, provided block C D is clear and provided there is no train on track-section H. If, however, there is a train already within section H', the battery a^2 is short-circuited, and if there is a train on track-section H^2 the circuit of battery a^2 is broken at relay R', while if there is a train on track-section H the circuit of battery a^2 is broken at relay R, so that the signal S^8 cannot be set to "safety" unless block C D and track-section H are clear.

The method of operation of these signals is as follows: Supposing that a train on the siding is desirous of entering the block C D, a person qualified to do so presses key K, thus breaking the upper contact and closing the lower contact of the key. The circuit of battery a^8 and of signals S^5 and S^6 is thereby broken and the circuit of battery a^2 is diverted through signal S^8, provided block C D and track-section H are clear, and the signal is thus set to "safety."

When a train passes from the main to the side track, it may not be regarded as having passed off from the main track until its rear car has passed the fouling-point, even though no wheels of this car are upon the rails of the main track. To prevent signals from being cleared until the train shall have completely cleared the main track, the ends of the siding may be insulated from the main portion thereof and may be connected electrically with the rails of the main track. The manner of making these connections is well known, and for the sake of simplicity I have not shown it in the drawings of this application.

The function of the hand-switch N is to make it possible, when necessary, to prevent the cutting-out of battery a^5 when a train is on the track-section H^2. Thus, if a train is on section H^2 and it is desired in spite of that fact to permit another train to enter the block D E at E, the switch N is opened, thus breaking the circuit of battery a^4 and causing the armature of relay R^2 to drop to normal position, thus cutting out of circuit signals S^3 and S^4 and completing the circuit of battery a^5, so that the presence of the train on the track-section H^5 causes signal S^7 to go to "safety." Signals S^3 and S^4 now being at "danger," and being kept at "danger" through the breaking of the circuit of battery a^{10} at relay R^5, it is not possible for the train on track-section H^2 to pass onward into block D E, and it is equally impossible for the train in the block D E to pass beyond signal S^5 into section H^2, for so long as the first train is on

section H^2 the circuit of battery a^2—the battery which operates signals S^5 and S^6—is broken at relay R′, so that signals S^5 and S^6 cannot be set for "safety." There is, therefore, no failure of the signals even if their normal operation be disturbed by the turning of switch N.

The function of switch N′ is similar to that of switch N. It will be noted that the turning of switch N′ cannot have the effect of admitting a train to the block C D at C while a train is on the track-section H^2, for the circuit of battery a^8 is broken at relay R′ so long as the train is on section H^2, and no other battery can affect signal S^2. In any case, therefore, a train is fully protected at its rear.

Switches similar to N and N′ may, of course, be placed at the other signal-stations for a similar purpose; but in general such switches will be needed only where there are side tracks.

If desired, short insulated sections of track on the siding may be provided with batteries and circuits operating relays which will take the place of keys K and K′, so that signals S^8 and S^9 may be operated automatically. In Fig. 3 I have illustrated such an arrangement for the sidings there shown.

Fig. 3 illustrates a track provided with two sidings, which join the main track at points very near together. These sidings are supposed to be located at station D of Fig. 2 instead of the single siding there shown, and the wires and rail-sections are therefore numbered to correspond with numbers at station D. H^6 and $H^{6'}$ are the sidings, and h and h' are the short insulated siding track-sections just referred to. S^{10} is the signal and r the relay corresponding to siding H^6, while S^{11} is the signal and r' the relay corresponding to siding $H^{6'}$. A car standing on track-section h short-circuits the battery of relay r, thus causing the armature of this relay to drop, breaking the circuit of the main-line signals, which are not shown in this figure, but would be connected to wire 32 extended, and placing signal S^{10} in circuit with the battery which supplies current to the rails of the track-section H′, this battery not being shown in this figure, but being battery a^2 of Fig. 2. Signal S^{10} is thus placed to "safety," while signal S^{11} remains at "danger." Signal S^{11} is operated in the same manner by a car standing on rail-section h'. Should two trains stand on the two track-sections h and h' at the same time, so that relays r and r' are operated, signal S^{10} alone will be set to "safety," since, as will be seen from the diagram, the circuit of signal S^{11} passes over wires 49′ and 50′ and through the upper contact of relay r, and this contact is broken when the circuit of signal S^{10} is closed. A train on siding H^6 therefore always has the right of way with this arrangement of circuits. This might, under some circumstances, lead to confusion—as, for instance, if, after a train on siding $H^{6'}$ had entered track-section h' and set to "safety" signal S^{11}, a second train on siding H^6 should enter track-section h on that siding. Signal S^{10} would then go to "safety" and signal S^{11} would return to the "danger" position, although the train on siding $H^{6'}$ might already be partly on the main track. If there were three sidings communicating with the main track a similar confusion would exist, a train on the first siding having the right of way over trains on the second and third sidings and a train on the second siding having the right of way over the train on the third siding. In Fig. 4 I have illustrated a simple interlocking device for preventing any such confusion. d is a disk revolubly mounted and arranged to be rotated by the handle k. About the circumference of this disk are arranged the relays r r', &c., controlling the siding-signals, their armatures being toward the circumference of the disk and in close proximity thereto when attracted to the poles of their magnets. s is a notch in the disk of a size suitable to receive one of these armatures. No armature can fall unless the notch s is in line with it, and when an armature has entered this notch s the disk cannot be turned. Since there is but one notch it is then impossible for a second armature to fall back far enough to make or break contact with its contact-points until the first armature has returned to "normal." Hence only one relay may be operated at once and only one signal can be set to "safety" at any one time, so that all confusion is avoided and it is insured that when one train has taken a route no other train can take a conflicting route until the first train has cleared the main track. It is not necessary that this disk should be turned by hand. The passage of a train onto any of the siding track-sections may be caused to move the armature of an electromagnet, and the motion of this armature may be caused to rotate the disk until the armature of the relay corresponding to the siding track-section falls into the notch s, when the disk will be locked and the corresponding signal set to "safety." When the train has passed off from the siding track-section, the magnet of the relay will be energized, so that the armature is drawn out of the notch s, and the disk can then be returned to "normal" by a spring or by other suitable means.

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

1. In an electrical railway signaling system, the combination, with two insulated blocks or sections of track, an electrically controlled signal for each block controlling the entrance of trains thereto, a signal circuit for each block controlling the signal of that block and passing through the rails of said block, a signal battery for each signal circuit, means for throwing the signal battery of each block into or out of its signal circuit, thereby setting to safety or to danger the signal of that block, and a circuit controller operated from the en-

trance of the second block and controlling the signal circuit of the first block, and arranged to set to danger or to hold at danger the signal of the first block when a train is entering the second block, substantially as described.

2. In an electrical railway signaling system, the combination, with two insulated blocks or sections of track, an electrically controlled signal for each block controlling the entrance of trains thereto, a signal circuit for each block controlling the signal of that block and passing through the rails of said block, a signal battery for each signal circuit, means for throwing each of said signals into and out of its signal circuit, and a circuit controller operated from the entrance of the second block and controlling the signal circuit of the first block, and arranged to break the signal circuit of the first block when a train is entering the second block, substantially as described.

3. In an electrical railway signaling system, the combination, with two insulated blocks or sections of track, an electrically controlled signal at each end of each block controlling the entrance of trains to said block, a signal battery at each end of each block, a line conductor for each block, and a circuit controller for each end of each block connected to the signal and battery at that end of that block and to the line conductor, and adapted to connect either said signal or said battery to the line conductor, and means for setting to danger or for holding at danger the signals of the first block when the signal of the second block situated at the station nearest the first block is at safety, substantially as described.

4. In an electrical railway signaling system, the combination, with two insulated blocks or sections of track, an electrically controlled signal at each end of each block controlling the entrance of trains to said block, a signal battery at each end of each block, a line conductor for each block, and a circuit controller for each end of each block connected to the signal and battery at that end of that block and to the line conductor, and adapted to connect either said signal or said battery to the line conductor, and means for breaking the line circuit of the first block when the signal of the second block situated at the station nearest the first block is in the line circuit of the second block, substantially as described.

5. In an electrical railway signaling system, the combination, with two or more blocks or sections of track, and a signal for each end of each block controlling the entrance of trains thereto, of a signal battery for each end of each block, an electrically operated circuit controller or switch for each end of each block connected to the signal circuit of the block and to the signal and signal battery of its end of the block, and adapted to connect either said signal or said battery to the signal circuit, and an insulated track section for each end of each block and a local circuit and battery therefor, controlling the circuit controller of that end of the block and connected to the rails of said insulated track section, the said insulated track section of each block being placed between the corresponding insulated track section of the adjoining block and the main track section of the adjoining block, substantially as described.

6. In an electrical railway signaling system, the combination, with two adjacent blocks or sections of track, C D and D E, and signals S^2 and S^4 controlling the entrance of trains to said blocks, of an insulated track section H^2, an electrically operated circuit controller R′ and a battery and circuit operating said circuit controller and adapted to cause the armature thereof to fall when wheels are on said track section H^2, an insulated track section H^3, an electrically operated circuit controller R^3 and a battery and circuit for operating said circuit controller adapted to cause the armature thereof to rise when wheels are on said track section H^3, a battery and circuit controlled by circuit controlling devices operated by the armature of circuit controller R′ and adapted to operate signal S^4 when wheels are on track section H^2, a battery and circuit for operating signal S^2, and circuit controlling devices operated by the movement of the armature of circuit controllers R′ and R^3, controlling the circuit of signal S^2, and adapted to prevent the operation of said signal when wheels are on either of said track sections H^2 or H^3, substantially as described.

7. In an electrical railway signaling system, the combination, with a block or section of track C D, having a siding at D, a line conductor extending throughout the block, signals S^2 and S^5 controlling the entrance of trains into the block at the ends C and D respectively and a signal S^8 controlling the entrance of trains into the block from the siding, said signals being electrically operated and arranged to indicate danger when no current is flowing through them, and signal batteries a^2 and a^8 at the ends C and D of said block respectively, of circuit controllers or switches R and R^3 at the ends C and D of said block, respectively, each connected to the signal and battery at its end of the block, and to the line conductor, and adapted to place either said signal or said battery in circuit with the line conductor, and a circuit controller or switch K, connected to circuit controller R^3, signal S^8, and the line conductor, and adapted when operated to cut said circuit controller R^3 out of circuit with the line conductor, thereby maintaining said signal S^5 at danger, and to place signal S^8 in circuit with the line conductor, substantially as described.

8. In an electrical railway signaling system, the combination, with a block or section of track C D having two or more sidings at D, a line conductor extending throughout the block, signals S^2 and S^5 controlling the entrance of trains into the block at the ends C and D respectively and signals S^{10}, S^{11}, &c.,

controlling the entrance of trains into the block from the sidings, said signals being electrically operated and arranged to indicate danger when no current is flowing through them, and signal batteries a^2 and a^8 at the ends C and D of said block respectively, of circuit controllers or switches R and R^3 at the ends C and D of said block, respectively, each connected to the signal and battery at its end of the block, and to the line conductor, and adapted to place either said signal or said battery in circuit with the line conductor, electrically operated circuit controllers or switches r, r', &c., corresponding to signals S^{10}, S^{11}, &c., respectively, each connected to the circuit controller R^3, to the line conductor, and to its corresponding signal, and adapted when operated to cut said circuit controller R^3 out of circuit with the line conductor, thereby maintaining signal S^5 at danger, and to place its corresponding signal in circuit with the line conductor, local batteries and circuits for each siding arranged to operate the circuit controller corresponding to said siding when a train passes from the siding to the main track, and an interlocking device controlling said siding signals and adapted to prevent one of said siding signals from being set to safety when another has already been set to safety, substantially as described.

9. In an electrical railway signaling system, the combination, with two adjacent blocks or sections of track, C D and D E, a line conductor for each block extending throughout the block, electrically controlled signals, S^2 and S^5, at the ends C and D of block C D respectively, and S^4 and S^7 at the ends D and E of block D E respectively, signal batteries a^2 and a^8 at the ends of block C D, signal batteries a^5 and a^{10} at the ends of block D E, and circuit controllers or switches R, R^3, and R^5 corresponding respectively to signals S^2, S^5, and S^7, each circuit controller being connected to its corresponding signal and battery and to the line circuit of its block, and being adapted to place either said signal or said battery in circuit with that line circuit, of an electrically operated circuit controller, R^2, corresponding to signal S^4, and connected to that signal, to battery a^5, and to the line circuit of block D E and adapted when operated to place either said signal or said battery in circuit with said line circuit, an electrically operated circuit controller R′, an insulated track section H^2 at the end D of block C D, a local battery and circuit therefor, connected to the rails of said track section and controlling said circuit controller R′, and adapted to cause the armature thereof to fall when wheels are on said track section H^2, a battery a^4 and local circuit for operating circuit controller R^2 controlled by circuit controller R′ and arranged to cause signal S^4 to be placed in circuit with the line circuit of block D E when circuit controller R′ is operated through the presence of wheels upon said track section H^2, a switch N adapted when operated to prevent the operation of circuit controller R^2 and the placing of signal S^4 in the line circuit, and conductors forming part of the line conductor of block C D and connected to circuit controllers R′ and R^3, and arranged to prevent the operation of the line circuit of that block when the armature of circuit controller R′ is down or when the circuit controller R^3 is operated to place signal S^5 in circuit with the line circuit of block D E, substantially as described.

10. In an electrical railway signaling system, the combination, with two or more interfering tracks, electrically controlled signals for controlling traffic on said tracks, and signal circuits and batteries for operating said signals, of circuit controlling switches or relays for operating said signal circuits, having operating levers arranged about a revolubly mounted disk which is provided with a notch in its periphery adapted to receive each of said levers when opposite the same, said circuit controlling devices being adapted each to operate its signal circuit when its operating or switch lever is within said notch, substantially as described.

11. In an electrical railway signaling system, the combination, with two or more interfering tracks, H^6 and $H^{6'}$, electrically controlled signals S^{10} and S^{11} controlling traffic on said tracks, and signal circuits and batteries for operating said signals, of circuit controlling switches or relays r and r' for operating said signal circuits, having operating levers arranged about a revolubly mounted disk d which is provided with a notch s in its periphery adapted to receive each of said levers when opposite the same, and contact points operated by the movement of the operating lever of each switch, and controlling the circuit of the signal corresponding to said switch, substantially as described.

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Witnesses:
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