No. 677,828. Patented July 2, 1901.

L. C. WERNER.

WIRELESS ELECTRIC RAILWAY SIGNALING SYSTEM.

(Application filed Dec. 30, 1899.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 1.

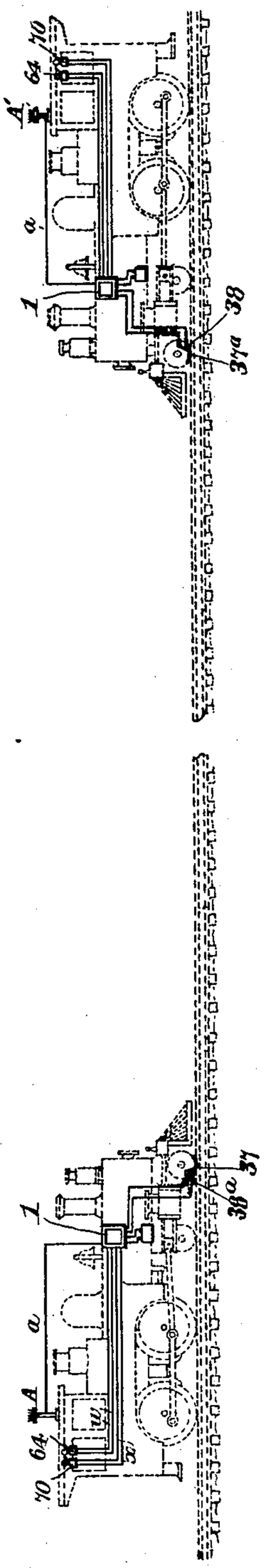
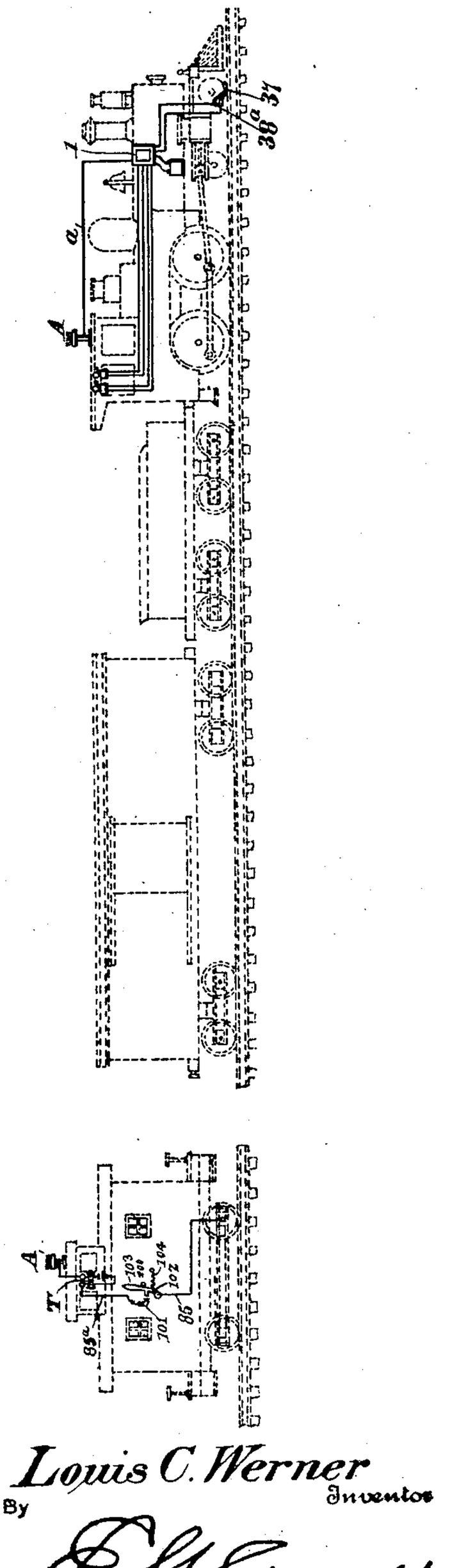


Fig. 2.



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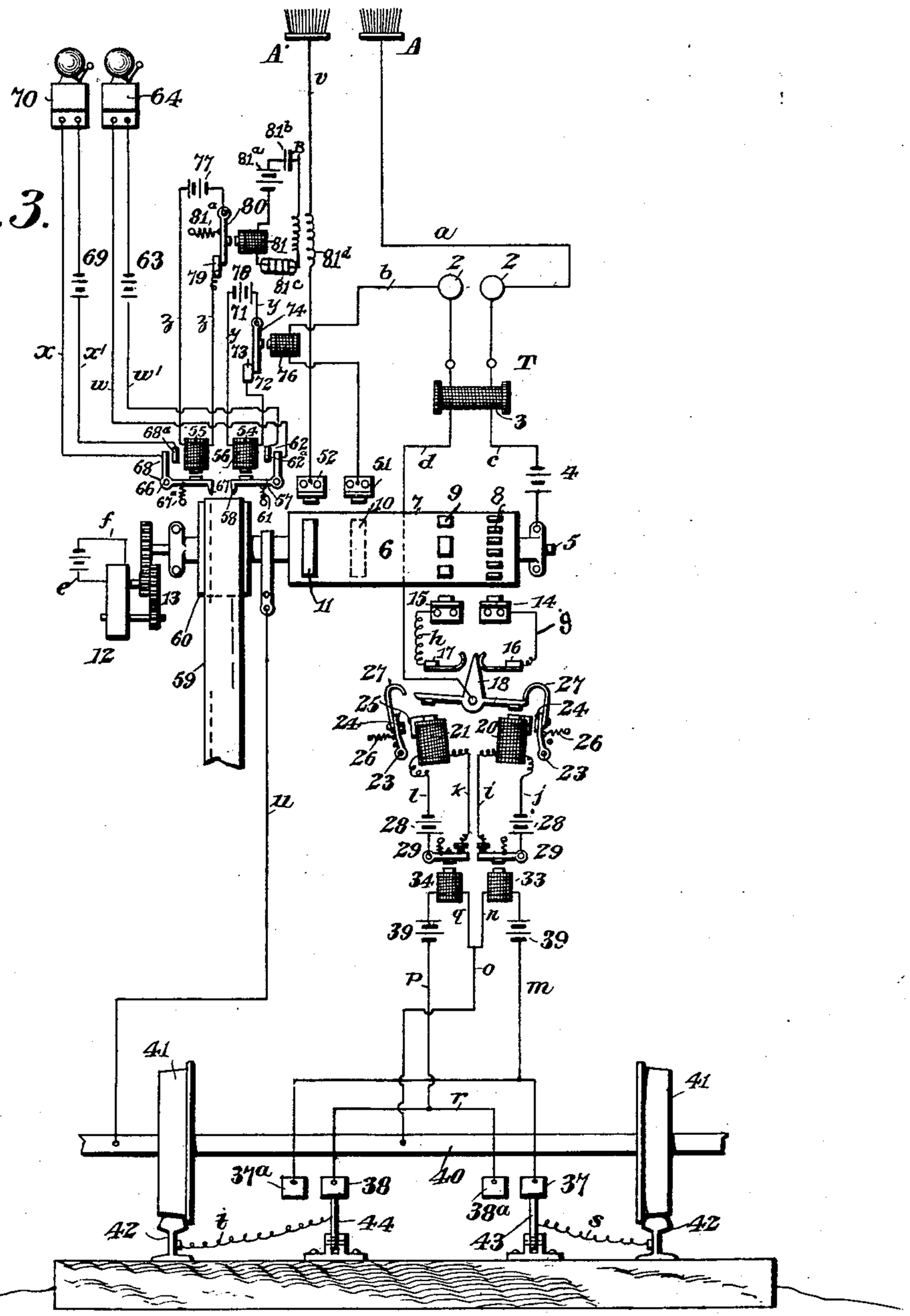
(No Model.) 4 Sheets—Sheet 2.

Fig. 3.



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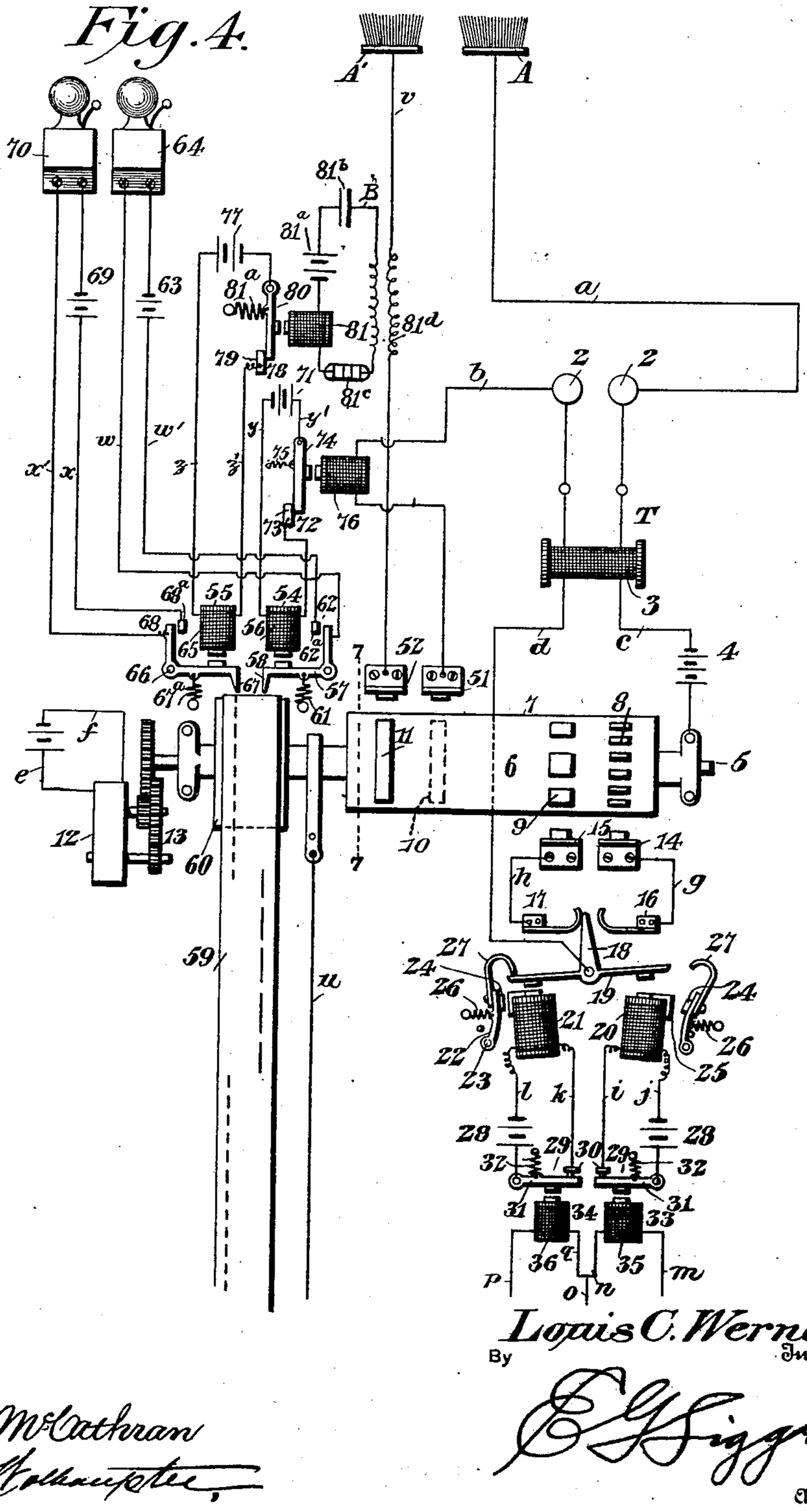
(No Model.) 4 Sheets—Sheet 3.

Fig. 4.



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(No Model.) 4 Sheets—Sheet 4.

Fig. 8.

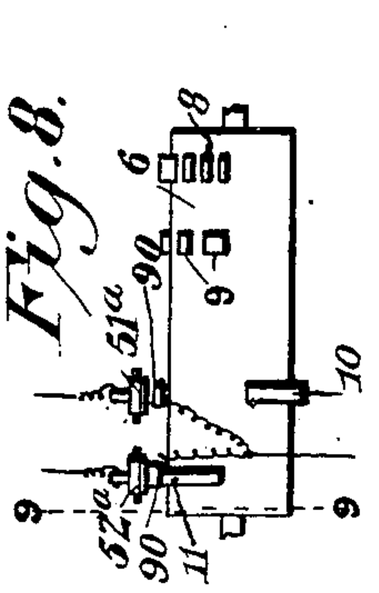


Fig. 9.

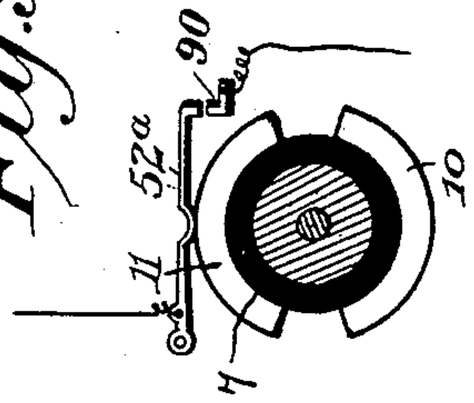


Fig. 5.

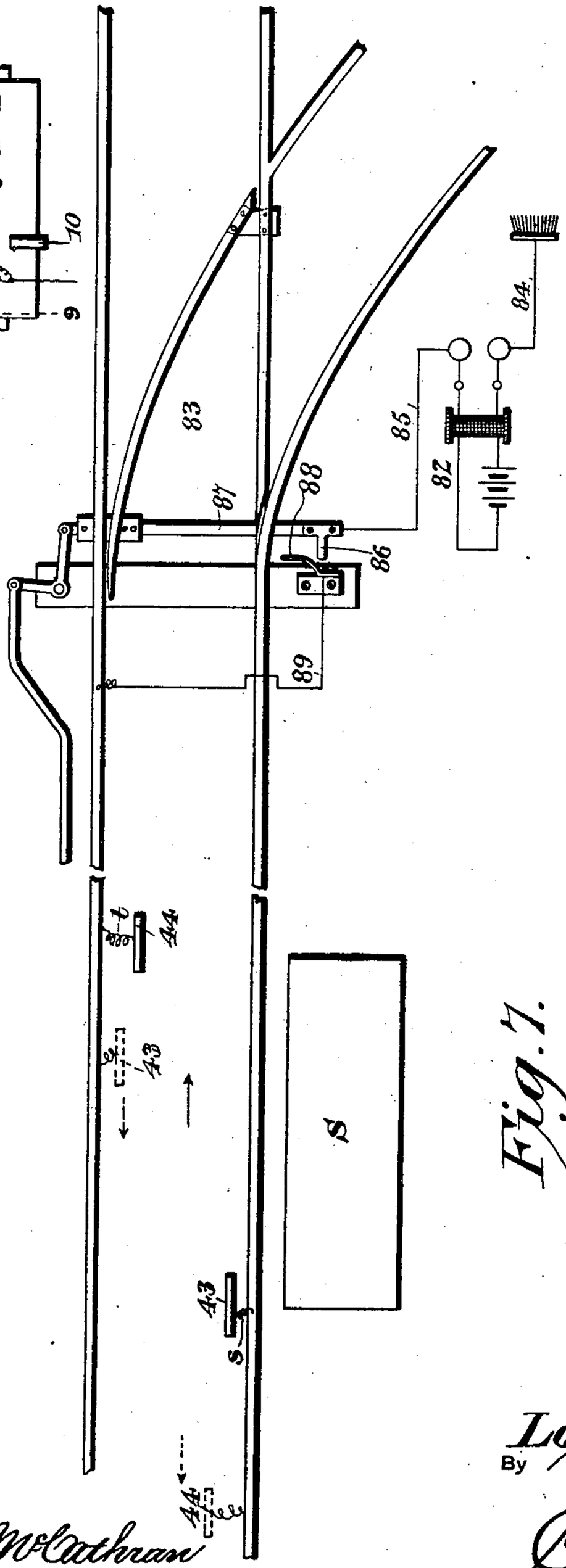


Fig. 6.

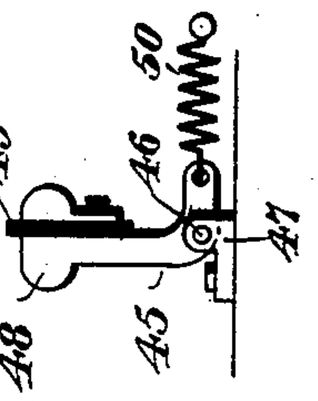
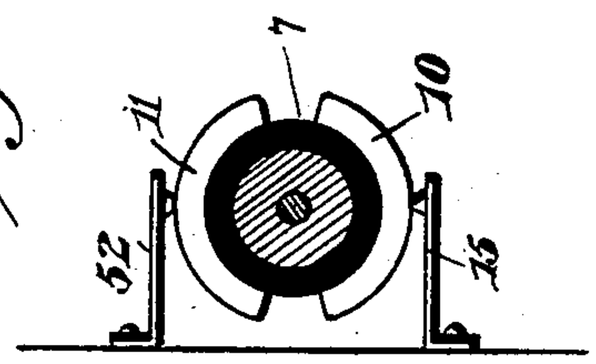


Fig. 7.



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UNITED STATES PATENT OFFICE.

LOUIS CHARLES WERNER, OF BROADBROOK, CONNECTICUT.

WIRELESS ELECTRIC RAILWAY SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 677,828, dated July 2, 1901.

Application filed December 30, 1899. Serial No. 742,095. (No model.)

To all whom it may concern:

Be it known that I, LOUIS CHARLES WERNER, a citizen of the United States, residing at Broadbrook, in the county of Hartford and State of Connecticut, have invented a new and useful Wireless Electrical Railway Signaling System, of which the following is a specification.

This invention relates to electrical railway signaling systems; and it has for one object to provide improved and practical means for adapting the wireless system of telegraphy to railway signaling for the purpose of signaling between trains coming in the same or different directions on the same track or at crossovers, as well as to provide positive and reliable means for signaling to and from stations from different parts of the same train, such as from a caboose, engineer's cab of a freight train, from switches, culverts, and, in fact, from any and all points where it is usual to provide signaling apparatus to transmit to the engineer a positive safety or a positive danger signal.

A further object of the invention is to combine with the necessary elements forming a part of the wireless system of telegraphy, such as employed by Marconi, improved means for automatically transmitting and receiving electrical impulses and to automatically and alternately throw the transmitting and receiving circuits of the train-apparatus signaling mechanism in and out of action.

Another object of the invention is to combine with the transmitting and receiving mechanism of the train apparatus improved recording mechanism operating synchronously therewith and also coöperating with suitable alarms, whereby an alarm will sound for transmitted signals and also for received signals, as well as for recording upon a suitable recording-tape the duration of the different signals, thereby providing a complete and accurate record of the action of the apparatus.

These and many other objects in view will readily appear as the nature of the invention is better understood; and the same consists in the novel construction, combination, and arrangement of parts, as hereinafter more fully described, and pointed out in the claims.

The present invention contemplates suitable means for practically operating the transmitting and receiving circuits of the wireless system of telegraphy in connection with the track and track-contacts of a railroad, and in carrying out these objects various expedients may be resorted to, while the preferred embodiment of the adaptation of said system of wireless telegraphy to railway signaling is shown in the accompanying drawings, in which—

Figure 1 is a diagrammatic view showing locomotives traveling in the opposite direction and equipped with the apparatus contemplated by the present invention. Fig. 2 is a similar view showing the caboose of a freight-train equipped with a transmitting instrument and shown broken from the train. Fig. 3 is a diagrammatic view of the complete train apparatus, including the track-contacts and the arrangement of the track-contact brushes. Fig. 4 is an enlarged diagrammatic view of the train apparatus, exclusive of the track-contacts and the track-contact brushes. Fig. 5 is a diagrammatic view showing the preferable arrangement of contacts at and near a station to provide for setting the apparatus to transmit the proper signals, said view also illustrating a practical method of associating a transmitting instrument with a switch. Fig. 6 is an enlarged detail elevation of one of the tilting track-contacts. Fig. 7 is a cross-sectional view of the continuously-operating signal-controller, the line-section being taken on the line 7 7 of Fig. 4. Fig. 8 is a detail elevation showing a modification of the signal-controller. Fig. 9 is a detail sectional view on the line 9 9 of Fig. 8.

Like characters of reference designate corresponding parts in all the figures of the drawings.

In the practical carrying out of the invention any of the ordinary transmitting and receiving instruments commonly employed in the wireless system of telegraphy may be utilized, and, in fact, the instruments employed in the Marconi system are well adapted for the purposes of the invention; so it is therefore not deemed necessary to enter into a specific description of the construction and action of the main transmitting and receiving instruments. It is necessary, however, to provide for securing the objects sought for

by the invention to equip each train with a duplicate apparatus, which apparatus is preferably carried by the locomotive and includes means not only for transmitting and receiving the signals, but also for sounding an alarm to notify the engineer of the action of the apparatus and to simultaneously record the electrical impulses. Exclusive of the alarm-bells, which I preferably arrange in the cab of a locomotive, the main working parts of the signaling mechanism may be mounted in a casing or boxing 1, supported in a convenient position upon the locomotive or any car forming a part of the train or may be used on a trolley or any electric car; but it will of course be understood that the entire mechanism or any part thereof may be arranged upon the train in such position or positions as may be found best adapted for securing a proper action of the apparatus.

Each train apparatus includes a signal-transmitting mechanism and a signal-receiving mechanism, which are separate and independent of each other and are provided with separate aerial conductors A A′, respectively, which aerial conductors are mounted on poles or other suitable supports carried in any convenient position for exposing the said aerial conductors in the atmosphere; but it will be understood that one aerial conductor may be used and that connected to both the transmitting and receiving instruments of the apparatus, as will be readily understood by those familiar with the art. There is no claim made in the present application upon any special arrangement of the aerial conductors, and it is simply proposed to use said conductors in the same way and for the same purpose as the corresponding conductors forming a part of the ordinary wireless system of telegraphy. It will be understood by those familiar with the art that the aerial conductors, or "terminals," as they are sometimes termed, are solely designed for use in connection with Hertzian waves or electrical waves produced by electrostatic discharges and capable of transmission to a distance through the intervening media.

The aerial conductor A of the transmitting mechanism is connected with one terminal of the secondary circuit *a b*, which circuit includes the usual balls 2 and the secondary winding of the Ruhmkorff coil 3, forming a part of the complete transmitting mechanism T, said reference-letter designating as an entirety the transmitting instrument, which may be of the usual type employed by Marconi and others in carrying out the wireless system of telegraphy. The primary winding of the Ruhmkorff or induction coil 3 is included in the primary circuit *c d*, the said circuit having its local battery 4, and the wire *c* thereof being connected with the metallic core 5 of the continuously-operating signal-controller 6, and it will of course be understood that an ordinary interrupter is included in the primary circuit of the coil, though not shown in the drawings. The said continuously-operating signal-controller 6 may be conveniently in the form of a cylindrical drum provided with an insulated periphery 7 and having a peripheral series of offset contact projections 8, 9, 10, and 11, which are insulated from each other by the insulation 7 on the periphery of the drum, but are in metallic contact with the core 5 of the drum for the purpose to be presently explained. At this point it may be explained that all the several contact projections 8, 9, 10, and 11 are not only arranged in different circular planes, but in different longitudinal planes, so as to come into play at different times, and the contact projections 8 and 9 are designed for use in connection with the transmitting mechanism, but are of different lengths or widths, so as to provide for transmitting impulses of different duration, according to the location of the train, it of course being understood that there is a succession or series of said contacts 8 and 9 to provide for carrying out the system of signaling by dots and dashes or equivalent characters. The other contacts 10 and 11 are respectively employed for completing the return connections for both the transmitting and the receiving circuits, as will be hereinafter more fully explained.

The circuit-controller 6, which, as stated, is preferably in the form of a drum, is mounted in suitable bearings, whereby the same may be continuously rotated, and this rotation may be automatically accomplished through the medium of an electric motor 12, having a suitable gearing connection 13 with the shaft of the drum and included in a local operating-circuit *e f*, which provides means for constantly energizing the motor, and thereby causing a constant rotation of the signal-controlling drum 6, whereby said drum will automatically throw the transmitting and receiving mechanisms alternately in and out of action.

The contact projections 8 and 9 of the signal-controller 6, which projections operate as a part of the transmitting mechanism, are designed to move in and out of contact, respectively, with a pair of brushes 14 and 15, arranged at one side of the drum 6 in spaced relation and respectively disposed in the circular path of movement of the contact projections 8 and 9 of the said drum. The said contact-brushes 14 and 15, respectively, have wire connections *g* and *h* with the spaced contact-plates 16 and 17. The contact-plates 16 and 17 are arranged in fixed positions and are preferably in the form of spring-plates projected inwardly toward each other, but out of metallic contact, so as to be alternately engaged by the contact-arm 18 of a single swinging switch-lever 19, which is in metallic connection with the wire *d* of the primary transmitting-circuit *c d* and which switch-lever also forms a part of an automatic circuit-changing switch for throwing either of the

contact-brushes 14 and 15 into the primary transmitting-circuit. The swinging switch-lever 19 is preferably in the form of a T-lever, whereby the contact-arm thereof is disposed centrally between its opposite ends in proper position for freely playing between and against the free ends of the contact-plates 16 and 17. The automatic circuit-changing switch not only includes the contact-plates 16 and 17 and the swinging switch-lever 19, but also a pair of switch-adjusting magnets 20 and 21, which magnets are arranged at an angle to each other and adapted to respectively coöperate with opposite ends of the lever 19 to provide for oscillating the same upon its fulcrum and to bring either of the series of contact projections 8 and 9 of the signal-controller into action, according to the character of the impulse which is to be transmitted as a signal. In this connection it is obvious that the action of the signal-controller does not provide for changing the character of the transmitted waves in a physical sense, but simply the signaling character of such impulses as may be produced by either the succession of contacts 8 or 9. It may be observed at this point that the switch-adjusting magnets 20 and 21 are in pairs, as well as all of the other electromagnets used in carrying out the system; but as it is common in the art to pair electromagnets it is not deemed necessary to illustrate the same except in diagram in the drawings. Therefore it will be understood that in referring to the different magnets singly such term will comprehend the usual pair.

To provide for holding the switch-lever 19 locked in either of its adjusted positions, each of the adjusting-magnets 20 has associated therewith a locking-armature 22, pivotally supported at one end, as at 23, at one side of the magnet and provided at or contiguous to its free swinging end with a keeper 24, coöperating with the lateral extension 25 of the exposed core end of the adjacent magnet. Each locking-armature 22 is pivotally supported at one side of the adjacent switch-adjusting magnet and is normally retracted away from said magnet by a retracting-spring 26, and at its free swinging end the said locking-armature is provided with a spring catch-hook 27, adapted to engage over one end of the swinging switch-lever 19 when such end of the switch-lever is retracted by the switch-adjusting magnet with which the locking-armature is associated.

The switch-adjusting magnets 20 and 21 of the automatic circuit-changing switch are normally energized. Said magnets are respectively included in their normally closed local operating-circuits $i\,j$ and $k\,l$, which circuits also include an independent local battery 28 and a normally closed circuit-closer 29. Each of said circuit-closers 29 consists of a fixed contact-plate 30 and a pivotal contact-armature 31, normally held in contact with the plate 30 by means of a retracting-spring 32. The pivotal contact-armatures 31 of the separate circuit-closers 29 respectively form a part of the track-relays 33 and 34, the relay 33 consisting of the magnet 35 and the armature 31, included in the operating-circuit $i\,j$, and the relay 35 comprising the magnet 36 and the armature 31, included in the operating-circuit $k\,l$.

There are associated with the track-relays 35 and 36 two sets of track-contact brushes 37 38 and 37^a 38^a, which operate in pairs. Only one pair of the track-contact brushes operate when the train is moving in one direction, while the other pair of such brushes operate while the train is moving in the opposite direction, so the description of the apparatus in connection with one pair of the contact-brushes will suffice for the other, it only being noted that the two pairs of brushes 37 38 and 37^a 38^a are arranged in reverse order, so that both pairs will operate in the same manner, though brought into play by the train moving in opposite directions. The track-contact brushes 37 37^a have a common bridge-wire connection with the circuit-wire m of the local track-relay circuit $m\,n$, which includes the magnet 35 of the relay 33 and the local battery 39. The wire n of the local track-relay circuit $m\,n$ is connected with the common return-wire o, which connects with the axle 40 of the locomotive or car truck, the wheels 41 of which axle travel on the track-rails 42. The other local track-relay circuit comprises the wires $p\,q$, and said circuit includes the magnet 36 of the relay 34. The wire p of the local track-relay and circuit $p\,q$ has a common bridge-wire connection r respectively with the track-contact brushes 38 38^a, while the other wire q connects with the common return-wire o. At this point it will be observed that the bridge-wire connections of both pairs of contacts provide means whereby the track-relays 33 and 34 will be actuated by the train when moving in either direction.

A practical way of carrying out the system of signaling in connection with the herein-described apparatus is to associate with track-contact brushes track-contacts 43 and 44, arranged, respectively, at the approach to a station S and in a proximal location beyond the station, the said contacts 43 and 44 being arranged at the inner side of the track-rails and respectively connected therewith by the wire connections s and t. The said track-contacts 43 and 44 are also respectively spaced at different distances from the adjacent rails, whereby the same will be respectively engaged by the brushes 37 38 or by the brushes 37^a 38^a, according to the direction in which the train is moving. While the track-contacts 43 and 44 may be of any suitable construction, the same are preferably in the form of bell-cranks 45, pivotally mounted at their angles, as at 46, in suitable bearing-brackets 47, secured upon the ties. Each of the pivotal bell-crank contacts is provided with an

upstanding contact-arm 48 of a sectional construction, with insulation 49 interposed between the sections thereof. Each bell-crank contact is normally sustained in a proper upright position by the adjusting-spring 50, connected with the lower arm thereof and also to a fixed point of adjustment. When the proper track-contact brush engages with one of the bell-crank track-contacts, the brush will strike that side of the contact which has the wire connection with the adjacent rail; but when the train is moving in the opposite direction the same contact-brush would strike the other side or section of the contact, and by reason of this side or section of the contact being insulated from the main section having the wire connection the brush would freely trip backwardly over the contact without interfering with the circuit.

The wire *b* of the secondary circuit *a b* of the transmitting mechanism is connected with a contact-brush 51, which is arranged above the signal-controlling drum 6, within the circular path of movement of the contact projection 10 thereof, to provide for completing the secondary transmitting-circuit through the common return-wire *u* for both the transmitting and receiving circuits. This common return-wire *u* is in one form of the invention shown in connection with the metallic core 5 of the drum 6 and also with the axle 4 of the locomotive or car truck. The circuit-wire *v* of the receiving mechanism or circuit also is connected with a contact-brush 52, which coöperates with the other return contact projection 11 of the drum 6, whereby the receiving-circuit may be completed through the common return-wire *u*. At this point it will be observed that this common return-wire provides means for completing the transmitting and receiving circuits through the track-rail, which is the equivalent of the earth connection used by Marconi and others in their systems of wireless telegraphy.

In carrying out the present invention there is associated with both the transmitting and receiving mechanisms, or at least with the operating-circuits of these mechanisms, a pair of recording instruments, (designated, respectively, by the numbers 54 and 55,) the instrument 54 being properly termed the "transmitted-signal" recorder, and the instrument 55 the "received-signal" recorder. Both instruments 54 and 55 are preferably in the form of relays, and the instrument 54 consists of the magnet 56 and the bell-crank armature 57, playing opposite the exposed end of the magnet, one end of which bell-crank armature is provided with a marking-point 58, working at one side of and against a suitable record-tape 59, working over the tape-feeding roll 60, which may be conveniently mounted upon the shaft of the signal-controlling drum 6, so that the tape will have unused portions thereof continuously exposed to the action of the markers coöperating therewith. The bell-crank armature 57 of the instrument 54 is normally drawn in the direction toward the tape 59 by the retracting-spring 61, and one arm of said bell-crank forms a part of a circuit-closer 62 for the local alarm-circuit *w w'*, which includes therein a battery 63 and an alarm-bell 64, which is preferably arranged in the engineer's cab and is designed as the alarm for transmitted signals. One of the wires of the local alarm-circuit *w w'* is metallically connected with the bell-crank armature 57, and the other of said wires is connected with the fixed contact 62^a, coöperating with the bell-crank armature 57 and forming a part of the circuit-closer 62. The other recording instrument 55 is similar in construction and action to the instrument 54. The said recording instrument 55, which acts in the capacity of a recorder for received signals, consists of a magnet 65 and a bell-crank armature 66, playing over the exposed core end of the magnet. The said bell-crank armature 66 of the instrument 55 is provided at one terminal thereof with a marking-point 67, which also works against the record-tape, but in a different position from the marking-point 58 of the other instrument 54, and the said bell-crank armature 66 is normally drawn toward the record-tape by the retracting-spring 67^a. One arm of the bell-crank 66 also constitutes part of a circuit-closer 68, consisting of an arm of the bell-crank 66 and a fixed contact 68^a, the said separate elements of the closer 68 having respectively connected therewith the separate wires of the local alarm-circuit *x x'*, which circuit includes therein a battery 69 and an alarm-bell 70, preferably arranged with the bell 64 in the engineer's cab, but of a different tone from said bell, so as to act in the capacity of an alarm for received signals.

The magnet 56 of the recording instrument or relay 54 is included in the normally closed operating-circuit *y y'*, which includes a battery 71 and a normally closed circuit-closer 72, consisting of a fixed contact 73 and the contact-armature 74, normally held against the fixed contact 73 by a retracting-spring 75. The said contact-armature is adapted to be drawn in one direction away from the fixed contact 73 by an operating-magnet 76, included in the secondary circuit *a b* of the transmitting mechanism.

The magnet 65 of the recording instrument or relay 55 is included in a normally closed operating-circuit *z z'*, which includes a battery 77, and a normally closed circuit-closer 78, consisting of a fixed contact 79 and a contact-armature 80, normally held in contact with the fixed contact 79 by a retracting-spring 81. The said contact-armature 80 is adapted to be moved in a direction away from the contact 79 under the influence of the operating-magnet 81, which is included in the receiving-circuit.

While the operating-magnet 81 may be properly referred to as being included in the receiving-circuit, still it will be understood

as necessary that a battery or some equivalent electrical source of energy independent of the Hertz wave must be included in the circuit of the said magnet for the purpose of energizing the same. The usual receiving mechanism, such as employed in the Marconi system, may be arranged in the circuit *u v;* but for illustrative purposes there is shown diagrammatically the necessary elements which coöperate with the wires *u v* and the magnet 81. Referring more particularly to the drawings, it will be seen that the magnet 81 is included in a separate battery-circuit, (designated by the letter B,) which battery-circuit has also included therein a battery 81^a, the usual condenser 81^b, the usual sensitive imperfect contact or "coherer" 81^c, and one coil of an induction coil or transformer 81^d, the other coil of which induction coil or transformer has connected therewith the wire *v*, which conducts the Hertz wave. The action of these several instrumentalities is precisely the same as in the Marconi system of telegraphy; but in the present invention the battery-circuit B is controlled by the coherer 81^c, influenced by the Hertz wave.

In Fig. 5 of the drawings the track-contacts 43 and 44 have been illustrated in full lines for the train traveling in one direction, assuming this direction to be north and indicated by the arrow. In the same figure the contacts 43 and 44 for a train traveling in the opposite direction are indicated as shown in dotted lines, it being assumed that the full-line contacts 43 and 44 are adapted to be respectively engaged by the track-contact brushes 37 38 and the dotted-line contacts 43 and 44 to be respectively engaged by the track-contact brushes 37^a 38^a when the train is moving in the opposite direction. The action would be the same in both cases, so it is only deemed necessary to describe the operation in connection with the contact-brushes 37 38 and the track-contacts shown in full lines in Fig. 5. Assuming the train to be traveling north, as indicated by the arrow in Fig. 5, upon approaching or reaching the station the track-contact brush 37 will come into operative engagement with the track-contact 43, thereby completing the circuit over the wire *m*, the magnet 35 of the track-relay 33, the wire *n*, the wire *o*, the axle 40, track-rail 42, wire *s*, and contact 43. The completion of this circuit energizes the magnet 35 and opens the circuit-closer 29, included in the local operating-circuit *i j* for the switch-adjusting magnet 20, thereby deënergizing this magnet, which permits the adjacent locking-armature 22 to be thrown out of engagement with the contiguous end of the switch-lever 19, which lever will thereupon be drawn by the attraction of the adjusting-magnet 21 into locking engagement with the locking-armature 22 of such magnet. Being thus reversed the contact-arm of the switch-lever 19 will engage with the contact-plate 17, and thereby provide for completing the primary circuit of the transmitting mechanism over the wire *c*, the metallic core 5 of the signal-controlling drum 6, the contact projections 9 of this drum, the contact-brush 15, the wire *h*, the contact-plate 17, the switch-lever 19, and the wire *d*. With the parts thus arranged the contact projections 9 will be active, and when coming into contact with the brush 15, associated therewith, will transmit to the aerial conductor A electrical impulses of any predetermined interval to provide for notifying engineers of trains beyond and approaching the station of the presence of the train at such point. When the train leaves the station, the track-contact brush 38 comes into operative engagement with the track-contact 44, thereby completing the relay-circuit over the wire *p*, the magnet 36 of the relay 34, wire *q*, return-wire *o*, axle 40, rail, wire *t*, and track-contact 44. This causes the energization of the magnet 36 of the relay 34, with a consequent opening of the circuit-closer 29, associated with the local operating-circuit *k l* of the adjusting-magnet 21. This magnet 21 becomes deënergized and permits of the other adjusting-magnet 20 to come into play and provides for the reversing of the switch-lever 19 in the same manner as already explained. When the switch-lever 19 is reversed under the attractive influence of its reversing-magnet 20, the contact-arm 18 thereof comes into engagement with the contact-plate 16, which changes the primary circuit, the transmitting mechanism from the contact projections 9 to the contact projections 8, which latter projections are of a different size from the projections 9, and therefore provide for transmitting different electrical impulses from the aerial conductor A, which impulses are arranged into a proper code of signals, so that they will be understood to notify engineers of approaching or following trains that a train has left the station.

By reason of the fact that the signal-controller 6 is constantly rotating, the brush 52, included in the signal-receiving circuit, will at short intervals be engaged by the contact projection 11, thereby setting the apparatus for automatically receiving messages from other points or trains; but it will be understood that the several contact projections of the signal-controlling drum 6 are arranged in such relation that when the projections for the transmitting-circuit are in play that for the receiving-circuit is out of action, so as to insure a proper operation of the apparatus and insure the automatic transmission and receiving of electrical impulses without interference. Whenever impulses are transmitted by the transmitting mechanism, the closing of the secondary circuit *a b* causes an energization of the operating-magnet 76, which serves to open the circuit-closer 72 and deënergize the magnet 56 of the recording instrument 54. This action permits the bell-crank armature 57 to move against the rec-

ord-tape 59 to make the proper record and at the same time close the circuit-closer 63, whereby the alarm 64 for transmitted signals will be sounded. The same action takes place whenever the circuit for the receiving mechanism is closed—that is, the magnet 81 opens the circuit-closer 78, thereby deënergizing the magnet 65 of the instrument 55 and permitting the armature 56 to make a record upon the tape 59 and at the same time close the circuit 68 for the alarm 70 for received signals.

In carrying out the invention there may be associated with the complete train apparatus, preferably carried by the locomotive of each train, transmitting instruments located at different points of danger to provide for communicating with the engineer of the train. For instance, as shown in Fig. 5 of the drawings, an ordinary transmitting instrument 82 may be associated with an ordinary switch 83, said transmitting instrument including an aerial conductor 84, mounted on a pole or otherwise suitably elevated above the ground, and which instrument 82 may be mounted in a box or other closure. The circuit of the instrument 82 is normally incomplete, and the return-wire 85 of the instrument may be conveniently connected by a contact-arm 86, movable with the switch-bar 87 and adapted to coöperate with a fixed contact-plate 88, arranged at one side of the track and having a wire connection 89 with one of the track-rails. It will therefore be seen that when the switch is opened for use the contact-arm 86 will be carried against the fixed plate 88, thereby completing the circuit of the transmitting instrument 82, whereby the switchman may notify of approaching trains, it of course being understood that the signals transmitted from the instrument 82 will be received by the receiving mechanism of each train apparatus which is operated in connection with a complete system.

The transmitting instrument 82, which may be of any of the usual forms, will not only be arranged for use in connection with the switch 83, but at culverts to indicate washouts, at highway-crossings, at crossovers, and even in connection with semaphore-signals, any suitable means being provided for completing or closing the transmitter-circuit when it is necessary to transmit a danger or other message to approaching trains.

Another way of utilizing the transmitting instrument 82 is by arranging such an instrument in the caboose of a freight-train, so that in the event of a caboose breaking away, as indicated in Fig. 2 of the drawings, the engineer of the same train can be promptly notified of the fact. In this use of the transmitting instrument 82 the circuit of said instrument is also normally incomplete, and the return connection 85^a thereof has included therein a normally open circuit-closer 100. This circuit-closer consists of the fixed contact-plate 101 and the pivotal lever 102, having a handle 103, normally held away from and out of contact with the fixed plate 101 by a retracting-spring 104. The said plate 101 and the lever 102 are respectively connected with separate portions of the return-wire 85^a, which return-wire is adapted to be included in the circuit with the track-rails. By moving the lever 102 in contact with the plate 101 the circuit of the transmitting instrument of the caboose will be completed, so that messages can be transmitted therefrom.

As already explained, the apparatus hereinafter described may be modified without departing from the essential feature of the invention, and various forms of continuously-operating signal-controllers for automatically cutting the transmitting and receiving circuits in and out of action may be resorted to. One modification of the signal-controller is shown in Figs. 8 and 9 of the dawings, which modification shows that the contact projections on the drum 6 may act in the capacity of tappets coöperating with pivotal contact-levers 51^a and 52^a, which are adapted to move in and out of contact with fixed contact-plates 90, having bridge-wire connections with the common return-wire *u* respectively for the transmitting and receiving circuits. The same idea could be embodied in connection with the contacts 8 and 9; but Figs. 8 and 9 of the drawings simply suggest one of many modifications that might be resorted to for the same purpose and which lie within the skill of the electrical engineer.

From the foregoing it is thought that the essential features of the invention, which provide for adapting the wireless system of telegraphy to railway signaling, will be readily understood without further description, and it will be understood that various changes in the size, shape, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is—

1. In an electrical railway wireless signaling system, a train apparatus provided with a signaling mechanism arranged to be included in a wireless circuit, and having an aerial conductor or terminal for Hertzian waves, said signaling mechanism also having a circuit including a track rail or rails, substantially as described.

2. In an electrical railway wireless signaling system, a signaling mechanism arranged to be included in the wireless circuit, said mechanism having an aerial conductor or terminal for Hertzian waves, and a circuit including a track rail or rails, and a separate track-circuit-closing device associated with said mechanism, substantially as set forth.

3. In an electrical wireless signaling system, a train apparatus provided with signal

transmitting and receiving mechanisms arranged to be included in a wireless circuit, each having an aerial conductor for Hertzian waves included in the circuits thereof, and means for automatically cutting the transmitting and receiving mechanisms in and out of action.

4. In an electrical railway wireless signaling system, a train apparatus provided with signal transmitting and receiving mechanisms arranged to be included in a wireless circuit each having an aerial conductor for Hertzian waves, and means for automatically cutting the transmitting and receiving mechanisms alternately in and out of action.

5. In an electrical railway wireless signaling system, a train apparatus provided with signal transmitting and receiving mechanisms arranged to be included in a wireless circuit each having an aerial conductor for Hertzian waves, and means for continuously opening and closing the transmitting and receiving circuits alternately, substantially as described.

6. In an electrical railway wireless signaling system, a train apparatus provided with transmitting and receiving mechanisms arranged to be included in a wireless circuit each having an aerial conductor for Hertzian waves, and a continuously-operating signal-controller having means for alternately cutting the transmitting and receiving mechanisms in and out of action.

7. In an electrical railway signaling system, a train apparatus provided with transmitting and receiving mechanisms each having an aerial conductor, and a continuously-operating signal-controller having means for alternately cutting the transmitting and receiving instruments in and out of action, and also for changing the character of transmitted impulses.

8. In an electrical railway signaling system, a train apparatus provided with transmitting and receiving mechanisms each having an aerial conductor, a continuously-operating signal-controller having means for alternately cutting the separate mechanisms in and out of action, and a circuit-changing device associated with the controller for automatically changing the character of the transmitted impulses.

9. In an electrical railway wireless signaling system, the signal-transmitting mechanism arranged to be included in a wireless circuit and having an aerial conductor for Hertzian waves, and means for automatically changing the signaling character of the electrical impulse transmitted by said mechanism, substantially as described.

10. In an electrical railway signaling system, a train apparatus provided with signal transmitting and receiving mechanisms each having an aerial conductor, a continuously-operating signal-controller having means for alternately cutting the transmitting and receiving mechanisms in and out of action, and an automatically-adjusting circuit-changing switch coöperating with the signal-controller to change the character of the transmitted impulses.

11. In an electrical railway signaling system, a train apparatus provided with signal transmitting and receiving mechanisms each having an aerial conductor, a continuously-operating signal-controller having means for automatically and alternately opening and closing the transmitting and receiving circuits, and an automatically-adjusted switch included in the primary circuit of the transmitting mechanism and coöperating with the signal-controller to change the character of the transmitted impulses.

12. In an electrical railway signaling system, a train apparatus provided with signaling transmitting and receiving mechanisms which have an aerial conductor, a continuously-operating signal-controller interposed in the primary and secondary circuits of the transmitting mechanisms, and also in the circuit of the receiving mechanism, an automatically-adjusted switch coöperating with the signal-controller to change the character of the transmitted impulses, and the switch-adjusting mechanism, including track-contacts and brushes coöperating therewith.

13. In an electrical railway signaling system, a train apparatus provided with signaling transmitting and receiving mechanisms, each having an aerial conductor, a continuously-operating signal-controller included in the primary and secondary circuits of the transmitting mechanism and also in the circuit of the receiving mechanism, a circuit-changing switch included in the primary circuit of the transmitting mechanism and cooperating with the signal-controller, a switch-adjusting mechanism including magnets for the movable switch member, track-relays associated with said magnets, track-contact brushes in the circuit of said relays, and track-contacts having circuit-wire connections with the track-rails.

14. In an electrical railway signaling system, a train apparatus provided with the transmitting and receiving mechanisms each having an aerial conductor, a continuously-operating signal-controlling drum provided with a plurality of contact projections, contact-brushes included in the secondary circuit of the transmitting mechanism and in the circuit of the receiving mechanism to respectively engage with different contact projections of the drum, a common return-wire adapted to be included in the circuit with either of said brushes and also with the track-rail, a pair of contact-brushes adapted to be respectively engaged by the other contact projections of the drum to provide for transmitting different impulses, and an automatically-adjusted circuit-changing switch including a pair of spaced plates respectively connected with the contact-brushes for transmitting signals, and a switch-lever playing

between and against the plates and included in the primary circuit of the transmitting mechanism.

15. In an electrical railway signaling system, a track apparatus provided with signal transmitting and receiving mechanisms each having an aerial conductor, a continuously-operating signal-controller having means for alternately cutting the transmitting and receiving mechanisms in and out of action, a circuit-changing switch included in the primary circuit of the transmitting mechanism, and essentially comprising a pair of spaced contact-plates and a swinging switch-lever adapted to play between and against said plates, separate switch-adjusting magnets arranged to oscillate the lever in opposite directions, spring-retracted locking-armatures controlled by said adjusting-magnets and having locking members adapted to engage with the ends of the switch-lever, a normally closed local operating-circuit for each of the said adjusting mechanisms, said operating-circuits including normally closed circuit-closers, track-relays including the movable members of said circuit-closers, the track-contact brushes wired with said relays and the track-contacts having wire connections with the relays, substantially as described.

16. In an electrical railway signaling system, the combination with the signaling mechanism and the track-contact brushes, of the track-contacts each consisting of a bell-crank lever provided with an upstanding sectional contact-arm having insulation between the sections thereof, and an adjusting-spring having a connection with one arm of said lever, substantially as described.

17. In an electrical railway signaling system, a track apparatus provided with signal transmitting and receiving mechanisms each having an aerial conductor, means for automatically cutting the transmitting and receiving mechanisms in and out of action, a suitably-operated record-tape, a pair of recording instruments each having an armature provided with a marking-point adapted to operate against the record-tape, a normally closed operating-circuit including the magnet of each relay, and also including a normally closed circuit-closer, and operating-magnets included in the secondary circuit of the transmitting mechanism and also in the circuit of the receiving mechanism, said operating-magnets respectively coöperating with the movable members of said normally closed circuit-closers.

18. In an electrical railway signaling system, a track apparatus provided with signaling transmitting and receiving mechanisms each having an aerial conductor, means for automatically cutting the transmitting and receiving mechanisms in and out of action, a suitably-operated record-tape, a pair of recording instruments each having an armature provided with a marking-point adapted to operate against the record-tape, a normally closed operating-circuit including the magnet of each relay, and also including a normally closed circuit-closer, operating-magnets included in the secondary circuit of the transmitting mechanism and also in the circuit of the receiving mechanism, said operating-magnets respectively coöperating with the movable members of said normally closed circuit-closers, and local alarm-circuits respectively for transmitted and received signals, each alarm-circuit including a normally open circuit-closer, the movable member of which is formed by the armature of one of the relays.

19. In an electrical railway signaling system, a train apparatus provided with signal transmitting and receiving mechanisms each having an aerial conductor, separate recording instruments for transmitted and received signals, separate alarms for transmitted and received signals, and means for automatically actuating the separate recording instruments and alarms respectively for the circuits of the transmitting and receiving mechanisms.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

LOUIS CHARLES WERNER.

Witnesses:
SYLVESTER BARBOUR,
E. M. FRANCIS.