C. J. KINTNER.

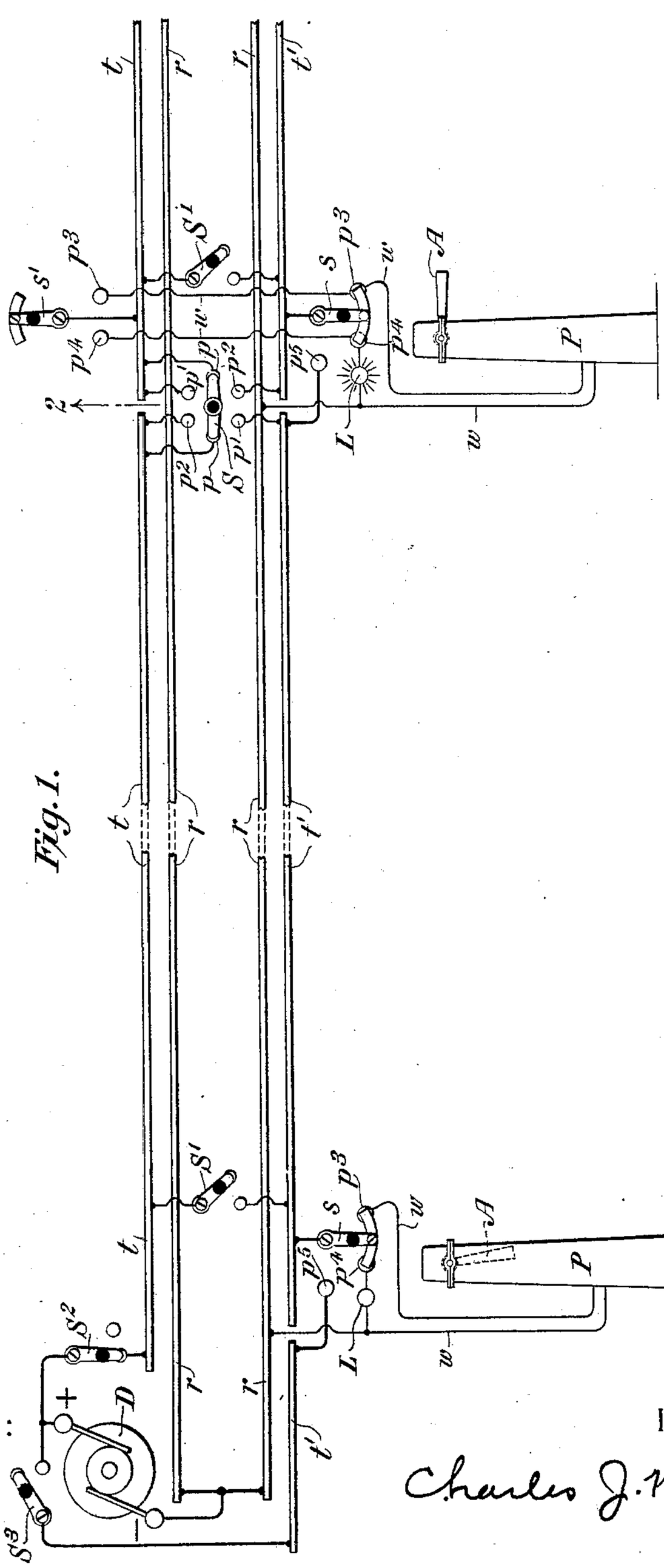
SAFETY SYSTEM FOR ELECTRIC RAILWAYS.

APPLICATION FILED JAN. 26, 1903. RENEWED MAY 9, 1905.

915,189. Patented Mar. 16, 1909.

5 SHEETS—SHEET 1.

Fig. 1.



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5 SHEETS—SHEET 2.

Fig. 2.

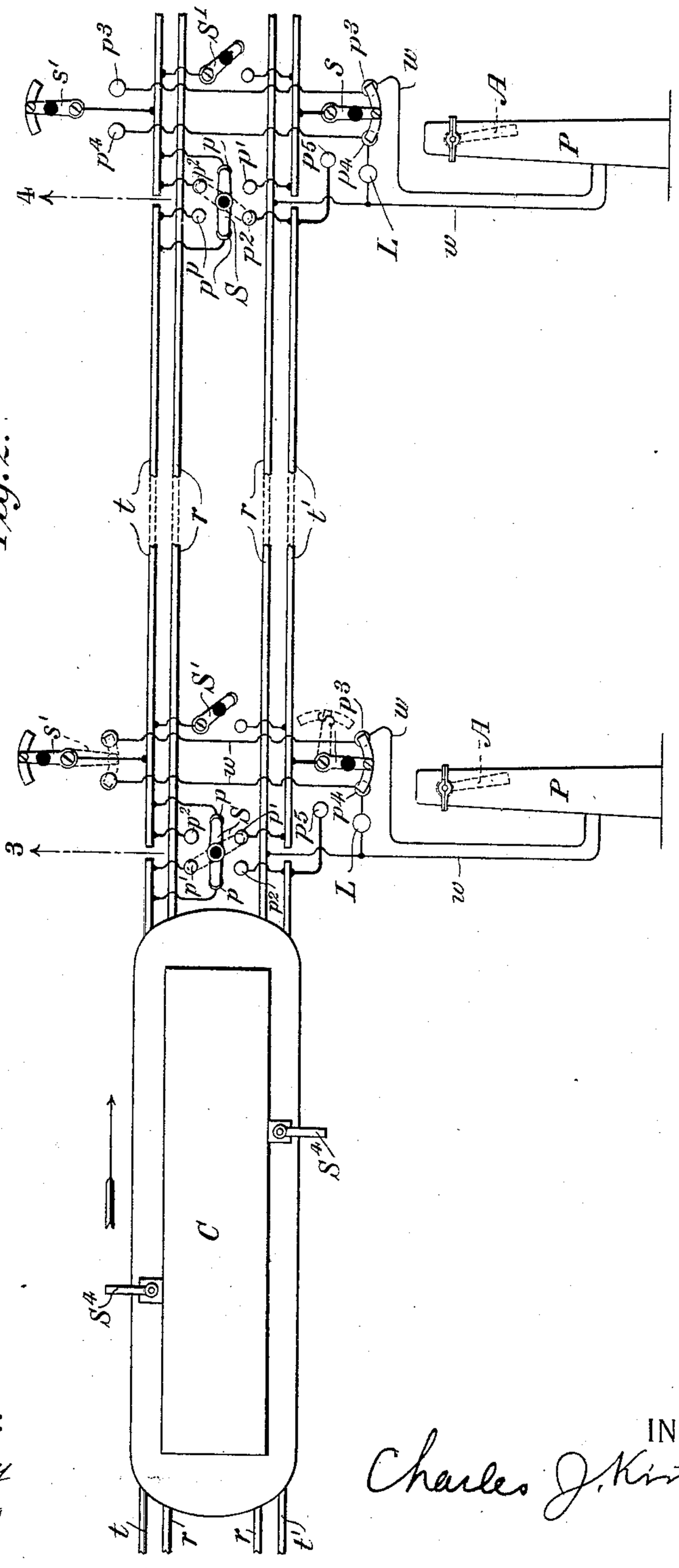

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Fig. 5.

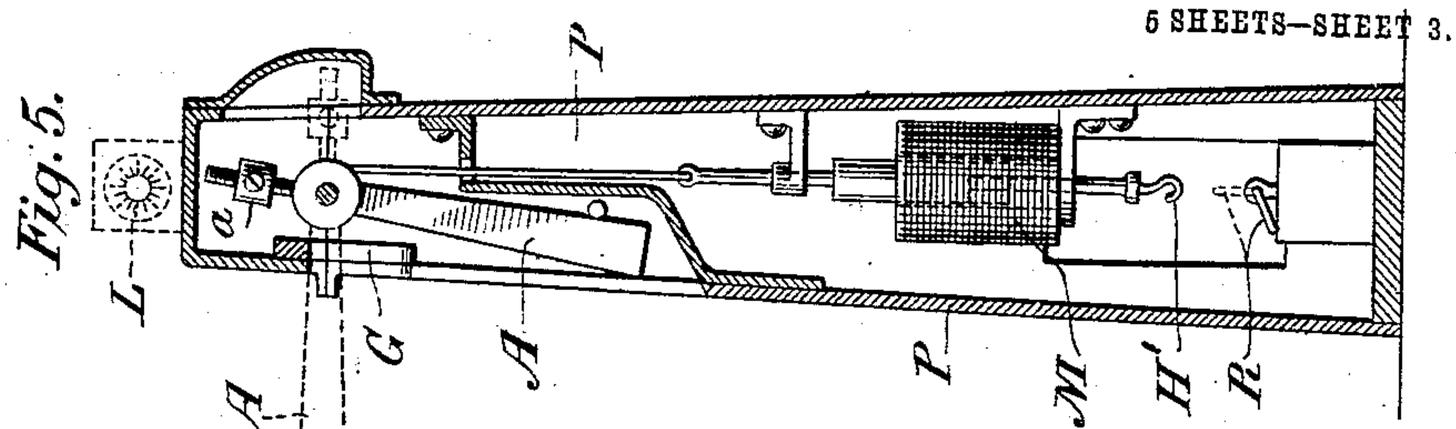


Fig. 4.

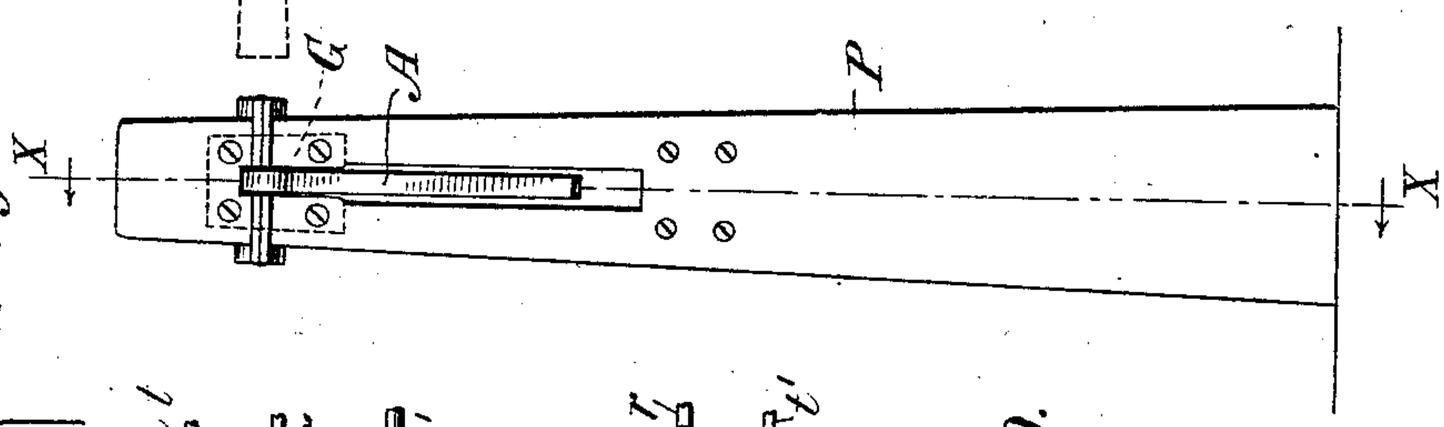


Fig. 6.

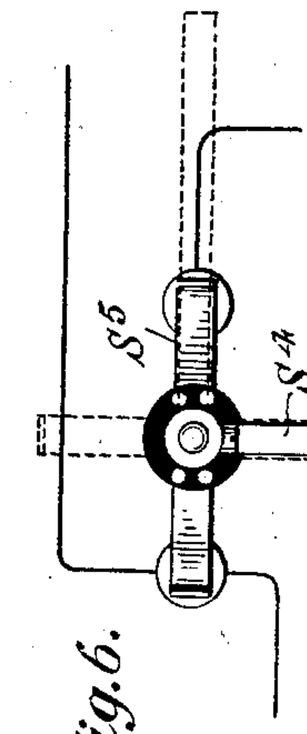


Fig. 3.

Fig. 9.

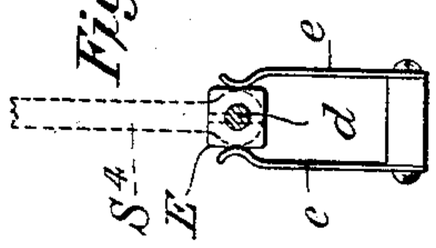


Fig. 8.

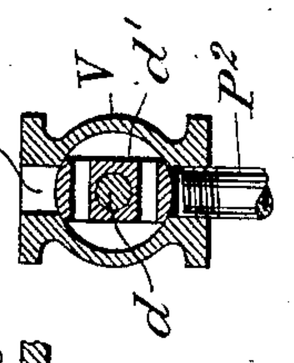
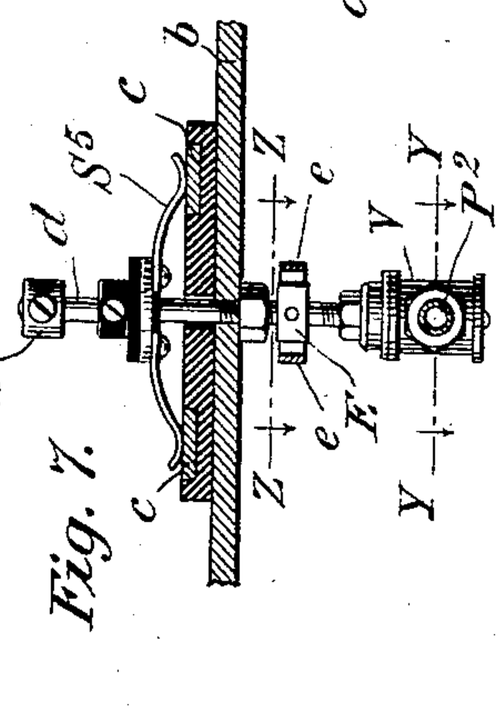


Fig. 7.



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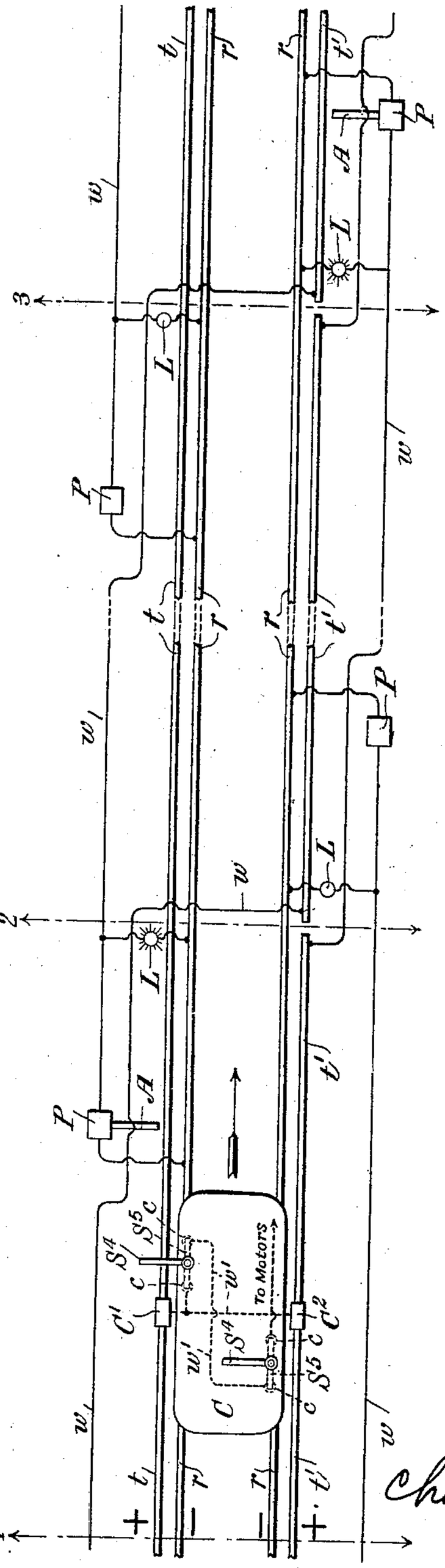
5 SHEETS—SHEET 4.

Fig. 10.



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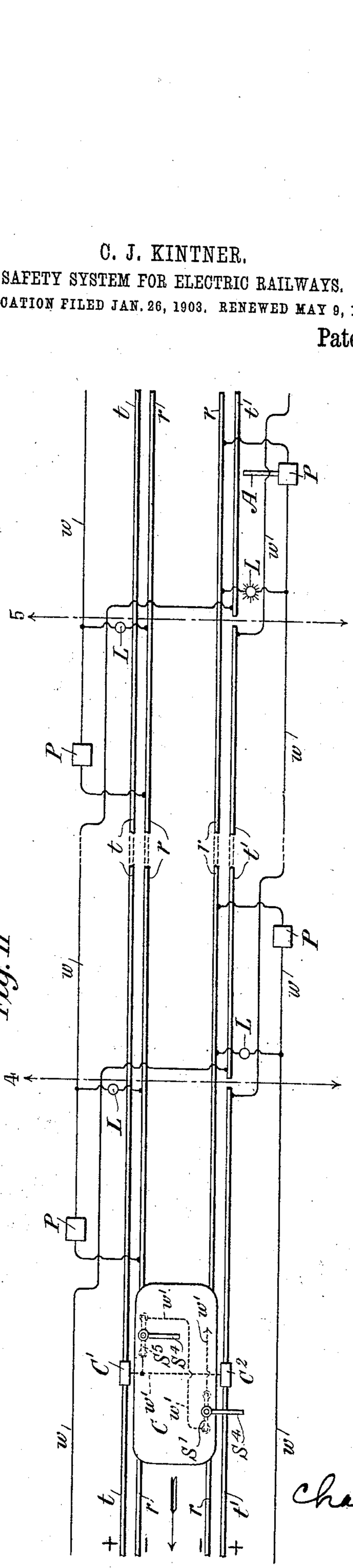
5 SHEETS—SHEET 5.

Fig. 11



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UNITED STATES PATENT OFFICE.

CHARLES J. KINTNER, OF NEW YORK, N. Y.

SAFETY SYSTEM FOR ELECTRIC RAILWAYS.

No. 915,189. Specification of Letters Patent. Patented March 16, 1909.

Application filed January 26, 1903, Serial No. 140,585. Renewed May 9, 1905. Serial No. 259,625.

To all whom it may concern:

Be it known that I, CHARLES J. KINTNER, a citizen of the United States, residing at New York, borough of Manhattan, county and State of New York, have made a new and useful Invention in Safety Systems of Electric Railways, of which the following is a specification.

My invention is directed to improvements in safety appliances generally for railways, but particularly applicable to electric railways of the third rail type, and it has for its objects, first, to prevent either front or rear end collisions through the agency of means carried by the cars and means located at intervals beside the track, through the conjoint action of which a car or train is automatically stopped in the event of its approaching too near another car or train preceding it; or, in the event of another car or train approaching too near to a car or train coming from the opposite direction. Second, to provide means whereby any particular part of the third rail or working conductor may be temporarily disconnected from said third rail or conductor and tested, repaired or replaced without delaying traffic. Third, to provide a system of electric railways with two sets of sectional working conductors or third rails located parallel with the tram rails and to combine therewith switches whereby the sections of the sectional working conductors or third rails may be interconnected with each other in any desired way and to the power house generator, in such manner as to make the system as flexible as possible. Fourth, to provide an electric railway system with a set of sectional controlling conductors for automatically controlling the stoppage of a car or train and to combine therewith switches and circuit connections whereby the lengths of such sectional conductors may be varied at pleasure so as to suit the conditions of traffic. Fifth, to provide a railway system with means in the nature of automatic train control apparatus carried by a car or train of cars, and one or more stop devices located beside the roadway and in close proximity to the car or train, at points ordinarily inaccessible to persons passing over the roadway, said stop devices being operated in one direction by an electromotive device and in a reverse direction by gravity and normally housed or concealed and adapted to be moved into operative relation with the train control apparatus. Sixth, to provide a car with train control apparatus located on each side thereof and two manual controllers for the motive power located at opposite ends of the car; together with stop devices located on opposite sides of the roadway and in close proximity thereto, whereby a car may run in opposite directions and be automatically stopped no matter in which direction it may be moving. Seventh, to provide an electric railway car with combined manual and automatic means of control mechanically disconnected from each other, and stop devices located beside the track, said stop devices being adapted, when actuated by the presence of a preceding car, to effect the operation of the automatic control apparatus upon the following car, there being two sets of such combined manual and automatic means on each car. Eighth, to provide an electric railway system with combined electrical and gravity actuated stop devices held normally out of operative relation with a controlling device carried by a car, and to combine therewith means for manually and automatically setting said stop devices for operation.

For a full and clear understanding of my invention such as will enable others skilled in the art to construct and use the same, reference is had to the accompanying drawings, in which—

Figures 1 and 2, of Sheets 1 and 2, when placed end to end with Fig. 1 on the left, represent diagrammatically an electric railway system embodying a number of the features of my invention and a car in plan view traveling thereover; Fig. 3 being an enlarged diagrammatic view illustrating the tram-rails, the third rails, the circuit connections to the motors on board of a car, the contact shoes or current collectors therefor, the train-pipe and brake controlling mechanism of an air-brake system, the controllers for the motors, the lamps for illuminating the car and a pair of switches located preferably on the roof and on opposite sides of the car; a signal post and operating arm for the purpose of effecting the automatic stoppage of the car being shown in plan view beside the track. Fig. 4 is a side elevational view of one of the signal posts and, Fig. 5 is a vertical longitudinal sectional view thereof taken on the line X—X Fig. 4 and as seen looking thereat from right to left in the direction of the arrows, a signal lamp being shown in dotted lines on top of the post.

Fig. 6 is a detail plan view illustrating in full and dotted lines the operation of the train control apparatus which effects the stoppage of the car or train. Fig. 7 is a transverse sectional view, taken on the line V—V Fig. 3 showing the train control apparatus and illustrating also the operative connection thereof with the valve which connects the train-pipe of the air-brake mechanism to the main air reservoir, not shown. Fig. 8 is an enlarged sectional view taken through Fig. 7 on the line Y—Y illustrating the exhaust valve of a well known type of air-brake mechanism, such as the Westinghouse, and its connection with a branch of the train-pipe. Fig. 9 is a sectional view taken through Fig. 7 on the line Z—Z. Figs. 10 and 11, of Sheets 4 and 5, when placed end to end with Fig. 10 on the left, illustrate the application of my invention to a single track; two cars in plan view being shown as approaching each other from opposite directions, and the semaphore posts being also shown in plan view, these figures illustrating how I prevent front or head-on and rear-end collisions.

Referring now to the drawings in detail in all of which like characters of reference represent like or equivalent parts wherever used and first to Figs. 1 to 9 inclusive, Sheets 1, 2 and 3, placing Fig. 1 on the left of Fig. 2, r, r, represent the tram-rails of an electric railway; D a power house dynamo having its negative pole connected thereto, the positive pole thereof being connected through a switch S^2 to the working conductor or third rail t, preferably about 15 inches therefrom, which in the present instance I have shown as being divided into four sections. t^1, t^1 is a similar conductor or third rail located at the same distance from the other tram-rail r and divided also into sections, the section on the extreme left at the power house generator being provided with a switch S^3 for connecting it to the positive pole thereof. The first section of this system extends from the power house generator to the vertical broken arrow 2; the second section extending from the arrow 2 to the arrow 3 and the third section extending from the arrow 3 to the arrow 4, and so on throughout the system. S, S, S, are rotary conducting switching arms located at the adjoining ends of the respective sections and adapted to make good electrical contact with oppositely disposed pairs of a series of switching contacts p, p, p^1, p^1, p^2, p^2 said switches being of the "sun flower" type and the arrangement such that both sets of sectional conductors may be connected together in any desired order, as will be more particulary described later on. s, s^1, s, s^1, s, s^1 are switches connected at their pivotal points directly to the sectional third rails t, t^1 and adapted to contact through curvilinear contact bars at their free ends with switching contacts p^3, p^4, p^3, p^4 the lower switches shown in the drawings being also adapted to contact with the contacts p^5, p^5, p^5, when turned to the extreme left, so as to connect the adjoining sectional third rails t^1, t^1 in series. P, P, P are signal or semaphore posts shown in enlarged view in Figs. 4 and 5, and A, A, A are combined semaphore or operating arms, in the nature of stop devices pivotally secured in said posts and provided each with a pulley operatively connected by a chain or cord to a vertically arranged sliding solenoid core of a solenoid M, the coils of which are connected in circuit with the conductors w, w, w, which in turn are connected on one side to the contacts p^3, p^3, p^3 and on the other to one of the tram-rails r. The semaphore posts P, P, P, are all located at the same distance from the tram-rails, and the semaphore arms which are pivotally supported in the upper ends thereof are all at the same height above the track and so arranged that their free ends when exposed will be at equal distances from the track and in the same plane with relation thereto for a purpose to be hereinafter described. L, L, L are signal lamps connected each in a multiple branch of the conductor w and designed to give night signals or to be used in tunnels or other places where light signals are required. Audible signals, such as tap bells, electrically actuated, may be substituted in place of signal lamps L. S^1, S^1, S^1 are stop switches which are connected on one side directly to the third rail t and adapted to contact at their free ends with the sectional third rails t^1 for the purpose of manually setting the signals and effecting the stoppage of cars or trains; said switches and the switches s, s^1 being preferably located within the semaphore posts and accessible only to authorized persons by lock and key through a door near the base thereof. H^1 is a hook at the lower end of the solenoid core and R a ring secured within the base of the semaphore post, the function of these parts being to manually set the semaphore arms A to their exposed positions, as shown in dotted lines, when it is desired to do so, in the event of the current having ceased to flow through the solenoid M when a switch S^1 has been operated or when it is desired to leave any of the semaphore arms permanently exposed. G is a bearing block at the upper edge of the opening through which the semaphore arm moves for affording a good bearing or leverage to the arm when operating the switching arms, as will be described later on. C represents a car shown in plan view passing over the section 2—3. S^4, S^4 are operating arms located on opposite sides of the car and preferably above the roof thereof and extending to the right and the left, so as to be located in the path of the semaphore arms A when the latter are

maintained in their exposed positions, as shown in dotted lines Fig. 5 and as shown in full lines in Fig. 3.

Referring particularly now to Fig. 3 I will describe the operative apparatus carried by a car for effecting the automatic stoppage thereof in the event of its approaching too near to a preceding car, the working conductors or third rails t, t^1 and tram rails r, r, being relatively located as before. C^1, C^2, C^1, C^2 represent pairs of contact shoes or current collectors at opposite ends of the car or train and on opposite sides thereof, the shoes C^1, C^1 resting on the third rail t and the shoes C^2, C^2 upon the sectional conductors or third rails t^1, t^1 when passing thereover. Said shoes are connected to each other and to the motors, controllers and switches by a series of conductors w^1, w^1 the circuit running to the motor including in series two yielding conducting switching arms S^5, S^5, the free ends of which rest upon metal contacts c, c, c, (see Fig. 7). Said switching arms are secured to a pivot rod d journaled in the top b of the car and each operatively connected to the switching arm S^4 adapted to extend, when the switches are in proper position, outward in each direction, in the path of the semaphore arms or stop devices A. The lower end of each of the pivot rods d is operatively connected to an exhaust valve d^1 in a valve-seat V having an exit P^3, said valve being located in a branch P^2 of the main train pipe P^1 connected to the main air-chamber of a well known system of air-brakes; H being the auxiliary air-chamber, F the triple valve and B the brake cylinder of the air-brakes adapted to apply brake pressure through the brake-bars E^1 and shoe brakes to the car-wheels W, W at the opposite ends of the axles A^1, A^1, these features being not substantially different from those found in the well known Westinghouse railway air-brake systems, my improvement in the present instance contemplating merely the application of a switch so arranged that the arm S^4 when acted upon by one of the exposed semaphore and operating arms A will automatically break the circuit to the motors and, at the same time, exhaust the air from the train-pipe P^1 so as to apply the brakes in a well known manner. E is a rectangular shaped metal block attached to the rod d and adapted to rotate between the free ends of two strong leaf springs e, e, in such manner that when the arm S^4 is turned as it comes into contact with a semaphore or operating arm A it will snap suddenly into its extreme left or right-hand position, as shown in dotted lines in Fig. 6, thereby breaking the motor circuit with a snapping action and fully opening the valve d^1 (see also Fig. 8.)

The parts hereinbefore described and particularly illustrated in Figs. 7, 8 and 9 of the drawings I denominate as double or duplex switches the same constituting train control devices or apparatus, with the conducting switching arms S^5 so arranged that either of the switching arms S^4 may assume either of two positions; namely, they may be so arranged that the free end of either of them may be in the outer or exposed position, while the other end thereof is in the inner or unexposed position, as more particularly illustrated in Figs. 10 and 11 of the drawings wherein two cars are shown and the circuit relations maintained through both switches.

D^1, D^1 represent the usual manual controllers for the motors and L^1, L^1, L^1 the lamps for lighting the car, the usual switches for connecting the lamps in circuit and for connecting and disconnecting the controllers being shown. The circuit arrangement of the motors and controllers with relation to series multiple or multiple series control, such as are now in general use, might of course be effected in any desired manner, this being well within the skill of those versed in the art and constituting no part of the present invention. As herein illustrated the front motor of the car moving in the direction of the large arrow is shown as in circuit through its controller D^1 and the rear motor is disconnected at the switch for its controller.

The train control apparatus illustrated in detail in Figs. 6, 7, 8 and 9 of the drawings is shown in Fig. 3 as being operatively connected in circuit with the motors, the motor controllers D^1, D^1 and mechanically connected with the air brake apparatus, there being two sets of such apparatus located on opposite sides of the car with the exposed operating arms extending outward beyond the sides of the car so as to adapt them for operation by stop devices located on opposite sides of each track where a double track system is employed, the arrangement being such that a car may be run in either direction and automatically stopped. This train control apparatus, it will be observed, is mechanically disconnected from the motor controllers D^1, D^1, but electrically connected in circuit therewith, whereby the automatic control of a car or train is wholly independent of the manual control thereof, no matter in which direction it may be moving. The stop devices shown in the drawings and particularly in Figs. 4 and 5 as semaphore arms A are normally housed and at points in the signal posts P sufficiently far above the roadway to prevent malicious persons from tampering therewith, the arrangement being such that neither human agencies or the elements, in the nature of snow, sleet, rain or wind, can under ordinary circumstances prevent their operation or in any way interfere therewith. Such stop devices as have heretofore been in general public use are ordinarily located in the road-bed, or if carried by signal posts are

so exposed as to render them subject to the actions of the weather, thereby offering a possibility of failure, as, for instance, through the collection of ice upon the exposed stop, whether located in the road-bed or at points inaccessible to trespassers.

The operation of this form of the apparatus is as follows—The car C is supposed to be passing over section 2—3 from left to right in the direction of the arrow beside it. Current is flowing from the power house dynamo D through the switch S^2 by the third rail *t*, switching arms S, S, S, and contacts *p*, *p*, *p*, in series relation, so that in the present instance, as shown, the third rail *t* is in effect one continuous conductor or third rail from the power house over the entire route, or to such points as additional sub-feeders are connected thereto in the usual way. The current, therefore, flows by the contact shoes C^1, C^1 (see Fig. 3) through the series of conductors w^1, w^2 on board of the car to the lamps L^1, front axle A^1, wheels W, W, tram-rails *r*, back to the power house, a branch thereof flowing by way of the two conducting switching arms S^5, S^5 to the front controller D^1 through the motor and the wheels W, W to the tram rails. Still another branch of the current flows by way of the current collectors C^2, C^2 to the sectional third rail t^1, on the opposite side of the track and from thence by the switch *s* at the rear-end of the section 2—3, one branch passing by the contact p^3, conductor *w* solenoid M (see Fig. 5) to the tram-rail *r;* another branch passing by the contact p^4 through the lamp L giving visual indication for night use of the fact that the car C is on the section 2—3. The semaphore arm A is therefore raised to its elevated position, as shown in dotted lines in Fig. 5 and full lines in Figs. 1 and 3, by the action of the solenoid M, thereby causing the free end thereof to be moved into the path of one of the train control devices or switching arms S^4, S^4 (see Fig. 3); consequently, a motorman of any car passing over the section between the power house generator and the entrance to section 2—3 will be made aware of the fact that there is a car on the preceding section by the danger lamp L and also by the semaphore arm A. Should he fail to observe the danger signals and run past the same, the arm S^4, as is obvious on inspection of Fig. 3, will come into mechanical contact with the semaphore arm A, thereby rotating said arm S^4 rear-ward to such an extent as to effectually rupture the motor circuit, and also at the same time turning the valve d^1 in the valve-seat V of the branch train-pipe P^2 into its open position, so as to exhaust the air from the main train-pipe and allow the triple valve F in the auxiliary air-chamber H to so act, as is well understood by those skilled in the art of air-brakes, as to apply the air brakes through the agency of the brake cylinder B and brake-rod E^1; consequently the car or train will be immediately automatically brought to a stop. Each signal or semaphore post P, P, P should preferably be placed a sufficient distance to the left of the entrance of its section to enable the car or train to be brought to a dead-stop before the front contact shoes C^1, C^2 reach the entrance of the next section in advance, as clearly indicated in Figs. 10 and 11 of the drawings. Should it be desired at any time to stop a car at any one of the points 2, 3 or 4, it is only necessary for an authorized person, as a station-master, track-walker or line repairer, to open the locked door at the base of the semaphore post and turn the corresponding free end of the switch S^1 on to its contact, thereby closing the circuit from the third rail or conductor *t* directly to the solenoid M of that particular semaphore signal, thereby bringing the semaphore arm A into the position indicated in dotted lines. The same effect may be obtained by mechanically locking the solenoid core in its lower position through the agency of the hook H^1 and ring R. Should it at any time be desired to make the signaling or operating sectional conductors t^1 of greater length than those indicated in the drawings, this may be effected by turning any switch *s* into its extreme left-hand position so that the curved contact plate at its free end rests only upon the contact p^5, thus connecting two sectional conductors together and at the same time disconnecting the solenoid M and lamp L for the particular section to which it belongs. In this way two or more of the sectional and signaling or operating conductors t^1 may be interconnected in series so that the lengths of such sections may be varied at will; leaving it always within the power, however, of an authorized person to stop a car or train at any intermediate points through the agency of the mechanically applied means, in the nature of a hook H^1 and ring R, as illustrated in Fig. 5 and as hereinbefore described.

I will now describe how the sectional working conductors or third rails *t*, *t* and signaling or operating conductors t^1, t^1 may be varied as to their respective relations in such manner as to enable authorized persons to test any one of such sectional working conductors as may be desired, or to make repairs thereon. To this end I provide switches s^1, s^1 operatively connected to the sectional conductors or third rails *t*, *t*, which are the duplicates of the switches *s* operatively connected to the conductors or third rails t^1, t^1. I also provide switching contacts p^3, p^4 operatively connected to the first-named switching contacts p^3, p^4. Suppose that it is desired to test that section of the working third rail or conductor *t* between the points 3 and 4, Fig. 2. The switches S, S at the opposite ends of the sec-

tion and the switches s, s^1 at the rear end of the section are turned into the positions shown in dotted lines, so that now tracing the direction of the flow of the current from the left the sectional conductor t^1 between the points 3 and 4 becomes a part of the working third rail or conductor t, conveying current to the working conductors and lamps as before through the contact shoes or current collectors C^2 (see Fig. 3) and the sectional conductor t which is now normally dead will, when a car passes over the section 3—4, convey current through the upper switch s^1 and the conductors w, w, to the solenoid M of the semaphore and the lamp L in the same manner as before, it being apparent that the connections have been simply reversed for the two conductors t, t^1, and the lower switch s disconnected from the contacts p^3, p^4, so that at any time when there is no car traveling over the section 3—4 authorized persons may test, repair, or effect such changes as may be necessitated upon the sectional conductor t; as, for instance, the removal of ice, or do anything which it would be dangerous to do if this conductor were connected directly to the working conductor or third rail, it being obvious, as before indicated, that the working current is now flowing continuously over the interconnected sections of the third rail or conductor t, t, t, to the point 3 and from there to the point 4, through the lower sectional conductor t^1, whence it passes by way of the switch S at the point 4 back to the continued interconnected sectional third rail or conductor t, and so on to the extreme end of the road.

When it is desired to use only the semaphores, the circular contact plates of the switches s or s^1 are placed solely on the contacts p^3. If it is desired to use only the signal lamps L, said contact plates are placed only upon the contacts p^4. Should it be at any time desirable to disconnect the third rail or conductor t from the generator and make tests, or changes in connection with the same, it would only be necessary to connect up all of the sectional conductors t^1 by placing the switches s, s, s, in connection with the contacts p^5, so as to make the third rail t^1 one continuous working conductor and connect the switch S^3 with the positive pole of the dynamo D; at the same time disconnecting the switch S^2 and all of the switches S from any of the series of contacts p, p, p^1, p^1, p^2, p^2 thus leaving the third rail t in position of successive dead-rail sections which might be tested in sections or repaired in any way; it being only necessary for the lineman or other expert effecting the tests or changes to abstain from working on any section at the time that any car or train is passing thereover. It is apparent, therefore, that with such a series of combined duplicate sectional conductors located on opposite sides of the tram-rails and at equal distances from the same and with the switching devices indicated it is entirely possible to, at any time, examine, test, or change any part of the system and that the same may be run either with or without the signals.

Referring now to Figs. 10 and 11 of the drawings, I will describe the application of my invention to a single track system showing how both rear-end and head-on collisions are prevented thereby, there being shown in these two figures of the drawings two cars C, C approaching each other from opposite directions, upon the supposition that the two figures of the drawings are placed end to end with Fig. 10 on the left. The working conductors and sectional signaling and operating conductors are divided into sections 1—2 2—3 3—4 4—5, etc. as before. One car is seen upon the section 1—2 approaching from the left and the other car upon the section 3—4 approaching from the right, in the direction of the arrows. The semaphore posts P are placed in each instance a distance from the outgoing ends of each section sufficient to enable the cars to be stopped before the shoes or current collectors C^1, C^2 pass upon the next section in advance and on opposite sides of the track. The circuit connections to the solenoids, not shown in these two figures of the drawings, are as described in connection with Figs. 1, 2 and 5, except that in this instance there are, of course, two sets of such conductors located on opposite sides of the track and extending in opposite directions from the adjoining ends of each pair of sectional working conductors to and through the electro-motive devices which control the movements of said semaphores and to the earth or return tram-rails r, r. The signal lamps or tap-bells L, L, are as before in multiple arc relation to the conductors w w. With this understanding the circuits will be traced upon the supposition that the two cars are approaching each other as before indicated and that the third rail or conductor t is continuous from the power house generator over the entire road, or is continuous as is customary in the art at intervals to feeders from independent power house generators. Current flows from the third rail t through the contact shoe or current collector C^1, conductors w^1, and switching arms S^5, S^5 in series to the motors on board of the car and through the car-wheels to the tram-rails r back to the generator; a branch thereof flowing directly from the current collector C^1 to the current collector C^2 and thence to the sectional third rail t^1 of the section 1—2; from thence by way of conductor w at the outgoing end of the section 1—2 to the solenoid in the second semaphore post P in advance preferably about 200 ft. from the incoming end of the section 3—4, so that the semaphore arm A is

exposed and at the same time the lamp L is ignited, thus giving to the motorman on board of the car in section 3—4 coming in the opposite direction two visual indications of the fact that there is a car approaching from the opposite direction on section 1—2. For the same reason current is flowing from the third rail *t* through the conductors w^1 and switching arms S^5, S^5 on the car advancing upon section 3—4 through the motors and the car-wheels to the tram or track rails and back to the power house generator. A branch of the current is also flowing from the current shoe or collector C^1 to the shoe or current collector C^2 through sectional conductor t^1 of section 3—4 and thence by the conductor *w* at the outgoing end 3 of section 3—4 to the solenoid in the second semaphore post P in advance about 200 ft. from the outgoing end of the section 1—2 and in multiple arc to the lamp L at the point, so that the semaphore arm A is exposed in advance of the car in section 1—2 and, at the same time, the lamp L in that section is illuminated; consequently, each motorman sees in front of him, first, a semaphore arm exposed, and second, a lamp giving a double indication of danger. Should either or both of them fail to observe these signals as their cars advance the arms S^4, S^4 will ultimately strike the free ends of the semaphores and interrupt the circuit to the motors at the switching arm S^5 and at the same time apply the brakes as before indicated.

It will be noted in this connection that the switching arms S^5 are adapted to rotate through 180° in either direction so that when the cars travel in opposite directions these switches may be turned to suit the conditions, as clearly indicated on the drawings. It is also to be noted that each sectional conductor or third rail t^1 is connected at its rear-end by a conductor *w* to a solenoid in the second semaphore post P, preferably about 200 ft. from the outgoing end of the next section but one in the rear and in multiple arc to a lamp L, for the purpose of giving signals to cars following, and also for the purpose of effecting the stoppage of said cars in the event of their approaching too close, as will be apparent on inspection of Fig. 11, it being obvious that the sectional conductor t^1 over which the car is passing on the section 3—4 is connected by a conductor *w* running to the second semaphore post P on the extreme right and about 200 ft. from the outgoing end of the section 5—6 to incoming cars. The same is true of any car following the car which is now on section 1—2, the sectional conductor *t* of that section being in like manner connected to a solenoid for a semaphore and a lamp in the rear. It is understood, therefore, that upon a single track system where cars run in both directions the conductors *w*, *w*, extend in pairs from the adjoining ends of each adjacent pair of sectional conductors t^1, t^1 in opposite directions entirely beyond the next adjacent ends of the corresponding adjoining sectional conductors for distances sufficient to warrant the stopping of a car coming in either direction before it enters upon the intermediate section; that is to say, if the car C is upon section 1—2 Fig. 10, to illustrate, the semaphore arm A, in the second post P at the right of the point 3 and upon the right-hand side of the track as the car advances, will be displayed by reason of the presence of the car upon that section and in like manner the second semaphore arm A in front of the second car C now standing upon section 3—4 and upon the right of the track as that car approaches will be displayed. For like reason the second semaphore arm A in the rear of car C standing upon section 3—4 will be displayed at a point at the right of the point 5. It will also be apparent that there will be a semaphore arm displayed in the second semaphore post in the rear of the car C now standing upon section 1—2 by reason of the current being closed from the rear end of the sectional third rail t^1 in section 1—2, and to a point beyond the next sectional third rail t^1 in the rear. With this arrangement of circuits, therefore, I am enabled to absolutely prevent either head-on or rear-end collisions, it being obvious on inspection of Figs. 10 and 11 that if the two cars advance, the one on the left will be automatically stopped before it reaches the point 2 and the other on the right before it reaches the point 3.

I do not limit my invention to the especial details of construction disclosed in the various modified forms illustrated in the accompanying drawings and hereinbefore described, as a number of the features thereof might be materially departed from and still come within the scope of my claims hereinafter made. Although I have illustrated the electromotive devices for effecting the control of the semaphore or operating arms as solenoids M, it is obvious that any electromotive device known in the art, such as an electric motor, might be substituted therefor, and various changes in the details of construction effected to adapt the application of such electromotive devices might obviously be made and still come within the scope of my claims.

I believe it is generically new with me to prevent either head-on or rear-end collisions in railways generally by the combined action of a train control or switching device carried by a car or locomotive and stationary devices located beside the road and adapted to be brought into operative relation with the train control or switching device in such manner as to actuate it when a car or locomotive is passing over a section of road in

advance of the point where the following stationary device is located and in maintaining said stationary operating devices in effective relation to the train control or switching devices carried by the cars or locomotives through the agency of an electric current maintained so long as the car or locomotive is passing over the section over which it is located for the time being, and my claims are designed to be of the most generic nature in this respect.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is;—

1. In a railway system a continuous third rail or contacting conductor connected to a source of electrical energy; a switching device carried by each car or train for automatically disconnecting the motor thereof from the source of power which drives it; in combination with semaphore arms located at intervals beside the track for automatically actuating said switching devices; together with electromotive devices for operating said semaphore arms, said electromotive devices being included in circuit with sectional third rails or conductors parallel with the track and each car or train provided with means for cross connecting said sectional conductors successively to the continuous third rail or contacting conductor, the arrangement being such that when a car or train is passing over a given section of the road any car or train immediately following the same will be automatically stopped should it approach too closely to the first-named car or train.

2. In a railway system a continuous third rail or contacting conductor connected to a source of electrical energy; a switching device carried by each car or train for automatically disconnecting the motor thereof from the source of power which drives it, said switching device being operatively connected to the brakes of the car or train; in combination with semaphore arms located at intervals beside the track for automatically actuating said switching devices; together with electromotive devices for operating said semaphore arms, said electromotive devices being included in circuit with sectional third rails or conductors parallel with the track and each car or train provided with means for cross connecting said sectional conductors successively to the continuous third rail or contacting conductor, the arrangement being such that when a car or train is passing over a given section of the road any car or train immediately following the same will be automatically stopped should it approach too closely to the first-named car or train.

3. In a single track railway system two or more cars provided each with a switching device for automatically disconnecting its motor from the source of power which drives it; in combination with means located at intervals beside the track and adapted to actuate the switching devices for cars traveling in opposite directions, said means being controlled by electromotive devices operatively connected to independent conductors extending in opposite directions from the opposite ends of each one of a series of sectional conductors or third rails; together with a continuous third rail or contacting conductor operatively connected to a source of electrical energy, the cars being provided each with current collecting devices for operatively connecting said sectional conductors in sequence to the source of electrical energy through the continuous third rail or contacting conductor.

4. In a single track railway system a series of sectional conductors parallel therewith; two or more cars or trains provided each with a switching device adapted to disconnect its motor from the source of power which drives it; means located beside the track for actuating said switches; electromotive devices for controlling the operation of said means, said electromotive devices being included in circuit with conductors w, w operatively connected in pairs to each one of the series of sectional conductors parallel with the track; in combination with a continuous third rail or contacting conductor operatively connected to a source of electrical energy; together with current collecting devices carried by the cars for connecting said sectional conductors in sequence to the source of electrical energy, the arrangement being such that head-on and rear-end collisions are avoided.

5. In a single track railway system a series of sectional conductors parallel therewith; two or more cars or trains provided each with a switching device adapted to disconnect its motor from the source of power which drives it and operatively connected to the brakes of the car or train; means located beside the track for actuating said switching devices; electromotive devices for controlling the operation of said means, said electromotive devices being included in circuit with conductors w, w operatively connected in pairs to each one of the series of sectional conductors parallel with the track; in combination with a continuous third rail or contacting conductor operatively connected to a source of electrical energy; together with current collecting devices carried by the cars for connecting said sectional conductors to the source of electrical energy, the arrangement being such that the source of power is automatically cut off from the motors which move the cars and the brakes automatically applied when cars approach too near to each other, whether the same be following each other or traveling in opposite directions.

6. In a system of electric railways a source of electrical energy; a conductor or third rail parallel with the track and connected to said source of electrical energy; a series of sectional conductors or third rails parallel with the first-named conductor or third rail; two or more cars each provided with interconnected contact shoes or current collectors adapted to simultaneously continuously contact with the third rail and to successively contact with the sectional conductors; electric motors for driving the cars, connected each to the before-mentioned current collectors or contact shoes and in circuit with a switch having an exposed operating arm or part adapted to be actuated from points exterior to the car; in combination with a series of operating arms located at intervals along the road and operatively connected with electromotive devices for controlling their movements, said electromotive devices being included in circuit with the before-mentioned sectional third rails or conductors and the tram-rails or return circuit to the source of electrical energy, whereby the motors of cars following each other too closely are automatically disconnected from the source of electrical energy.

7. In a system of electric railways a source of electrical energy; a conductor or third rail parallel with the track and connected to said source of electrical energy; a series of sectional conductors or third rails parallel with the first-named conductor or third rail; two or more cars each provided with interconnected contact shoes or current collectors adapted one to continuously contact with the third rail and the other to contact with the sectional conductors in sequence; electric motors for driving the cars, connected each to the before-mentioned current collectors or contact shoes and in circuit with a switch having an exposed operating arm or part adapted to be actuated from points exterior to the car; a source of energy for applying the brakes operatively connected to the before-mentioned switch; in combination with a series of operating arms located at intervals along the road and operatively connected with electromotive devices for controlling their movements, said electromotive devices being included in circuit with the before-mentioned sectional third rails or conductors and the return circuit to the source of electrical energy, whereby the motors of cars following each other too closely are automatically disconnected from the source of electrical energy and the brakes automatically applied.

8. In a system of electric railways a source of electrical energy; a conductor or third rail parallel with the track and connected to said source of electrical energy; a series of sectional conductors or third rails parallel with the first-named conductor or third rail; means carried by the cars for automatically disconnecting the motors thereof from the source of electrical energy; means located beside the track and operatively connected through electromotive devices to the before-mentioned sectional conductors or third rails; in combination with means carried by the car for connecting the third rail to the motors on board the cars and simultaneously connecting the sectional third rails in sequence to the first-named third rail and to the motive devices beside the track, the arrangement being such that when a car is passing over any given section the means for that section located beside the track and controlled by the electromotive device connected to the sectional conductor thereof is caused to actuate the automatic means carried by the car so as to disconnect the motor thereof from the source of electrical energy.

9. In a railway system a series of sectional rails or conductors extending over the route; in combination with a current feeder or main parallel therewith and operatively connected to a source of electrical energy; together with signaling devices operatively connected one to each sectional rail or conductor and switches adapted to connect the sectional rails or conductors in series relation, the arrangement being such that any signaling device may be temporarily cut out of circuit and the signaling device remaining in connection with the sectional rails or conductors thus interconnected acts for the block section of increased length.

10. In a block system of electric railways a source of electrical energy operatively connected to a third rail or conductor parallel with the track; in combination with a series of sectional third rails or conductors parallel therewith and operatively connected each by a conductor to an electro-motive device controlling a signal, switches for varying the lengths of the signaling blocks by connecting the aforesaid sectional conductors or third rails, and additional switches for cutting out the signals together in series relation.

11. In a system of electric railways a source of electrical energy; two third rails or conductors parallel with the track, each of said third rails or conductors being divided into sections of definite lengths; in combination with switches located at the ends of adjoining sections of both sets of sectional third rails or conductors for connecting two or more of either set in series relation; together with additional switches for cross-connecting the same in any desired relation.

12. In a system of electric railways a source of electrical energy; two third rails or conductors parallel with the track; switches for connecting either of said third rails or conductors to the source of electrical energy, said third rails or conductors being divided into sections of definite lengths; in combina-

tion with switches for connecting the sections of either third rail or conductor in series relation and additional switches for cross connecting them in any desired length.

13. In a system of electric railways a source of electrical energy; a continuous contacting third rail or trolley conductor operatively connected thereto; a series of contacting sectional third rails parallel therewith; means carried by the car for automatically stopping the same; means located beside the track and operatively connected with electro-motive devices connected in turn to the sectional third rails and adapted to actuate the means carried by the cars.

14. In a system of electric railways a source of electrical energy; a continuous contacting third rail or trolley conductor operatively connected thereto; a series of contacting sectional third rails parallel therewith; means carried by the cars for automatically stopping the same; means located beside the track and operatively connected with electromotive devices connected in turn to the sectional third rails and adapted to actuate the means carried by the cars; in combination with switching devices for manually operating the electromotive devices.

15. In a block system of electric railways a contacting third rail or trolley conductor extending over the route; a series of sectional third rails or contacting conductors parallel therewith each operatively connected to an electromotive device controlling a signal; in combination with switching devices located at the ends of said sectional third rails or contacting conductors and adapted each to disconnect its particular electromotive device and to connect the adjoining sectional third rails in series relation whereby any signal may be cut out of circuit and two or more sectional third rails or conductors constituted as a single block section operatively connected with a single signal.

16. In a block system of electric railways a series of sectional signaling conductors and a car provided with means for connecting the same in sequence with a source of electrical energy, said sectional signaling conductors being each operatively connected with an electromotive device controlling a signal; in combination with switches at the adjoining ends of the sectional signaling conductors adapted to connect the same together in series relation and to disconnect the corresponding signals, the arrangement being such that any two or more sectional signaling conductors may be operatively connected in series relation to a single signal and constitute a single block or signaling section.

17. In a railway system means carried by a car for automatically disconnecting its motor from its source of power; in combination with stop devices located at intervals beside the track and operatively connected with means controlled by the movement of a preceding car or train for automatically actuating said means, said stop devices being operated in opposite directions by electromotive devices and gravity and all held normally out of action and wholly protected from the elements.

18. In a railway system means carried by a car for automatically disconnecting its motor from its source of power; in combination with stop devices located at intervals beside the track and controlled in their movements by a source of electrical energy and gravity, said stop devices being held normally out of action; together with means for manually operating them in such manner as to cause the car or train to be stopped when the manual means is actuated.

19. In a railway system a car or train provided with a train control device; in combination with a stop device for actuating the same located beside the track and actuated in opposite directions by a source of electrical energy and gravity, said stop device being held normally out of action and housed or concealed from view; together with means for manually placing said stop device in operative relation with the control device when desired.

20. In a system of electric railways two third rails parallel with the track, said third rails or conductors being divided into sections and provided with switching devices for connecting them together either in series relation or for cross connecting them the one set to the other, in combination with means located at intervals beside the track for stopping the cars, said means being controlled by electromotive devices operatively connected to the sectional conductors through switches so arranged that the same may be operated from either set of said sectional conductors; together with means carried also by the cars for cross connecting said sectional conductors, said means being also electrically connected to the motors on the cars.

21. In a system of electric railways a source of electrical energy and two third rails or conductors parallel with the track, said third rails being divided into sections and provided with switches for connecting them together either in series relation or for cross-connecting them in zigzag relation; in combination with means located at intervals beside the track for stopping the cars, said means being operated by electromotive devices operatively connected in circuit to the sectional third rails or conductors by switches; together with switches for manually controlling the electromotive devices and means carried by the cars for connecting both third rails together electrically, said means being also operatively connected to the motors on board the cars.

22. In a system of electric railways two third rails parallel and at equal distances from the track-rails, one of said third rails being divided into sections operatively connected to electromotive devices adapted to control means for stopping the cars; in combination with switches for disconnecting said sectional third rails from their respective electromotive devices and for connecting them to each other in series relation; together with means carried by the cars for electrically connecting both third rails, said means being also electrically connected to the motors on the cars.

23. In a system of railways one or more cars provided each with safety appliances in the nature of double or duplex switches located on opposite sides of the car or cars and adapted to automatically disconnect the motors thereof from the source of power; in combination with means located at intervals beside the track for operating said switches, the switches being provided with arms adapted to extend into the path of the aforesaid means and so constructed and arranged that the arms may be rotated out of and into operative relation with the means so as to leave one operative switch in position to operate on one side of the car and the other closed, but out of operative position on the other side of the car.

24. A car provided with automatic train control apparatus located on opposite sides thereof; a manually operative train controller at each end thereof, both adapted to control the application of the motive power; in combination with stop devices on each side of the track for actuating the automatic control apparatus, substantially as described.

25. A railway car provided with two electric motors for propelling it; manual controllers for independently regulating the current flow therethrough, and two independent automatic controllers electrically interconnected and provided with circuits and circuit connections for connecting them to the motors, but mechanically disconnected from the manual controllers, substantially as described.

26. A railway car provided with two electric motors for propelling it; a manually operative controller for each motor and two automatic controllers electrically connected together and having circuit connections for both motors; in combination with means beside the track for actuating the proper automatic controller when it becomes necessary to stop the car by reason of an abnormal danger condition, substantially as described.

27. A railway car provided with electric motors, one relatively near each end thereof, and a manual controller for each; two automatic controllers adapted to be electrically interconnected and to the motors; in combination with a stop device beside the track held normally out of action with both automatic controllers but adapted when actuated to operate the proper one and stop the car, substantially as described.

28. A railway car provided with a propelling electric motor near each end; a current collector or shoe similarly located; a manual controller and an automatic control apparatus for each motor, the latter located on opposite sides of the car; in combination with circuits and circuit connections therefor and stop devices located on opposite sides of the track, substantially as described.

29. A railway car provided with a propelling electric motor near each end thereof; two pairs of current collectors or shoes similarly located and adapted to contact with third rails on either side of the car as it moves in either direction; a manual controller at each end of the car; an automatic control apparatus on each side of the car and electrical connections therefor; in combination with stop devices located beside the track and adapted, when exposed or put in action, to operate the proper one of the automatic controllers, substantially as described.

30. A railway car provided with a propelling electric motor near each end; a pair of current collectors or shoes similarly located and adapted to contact with third rails on either side of the car as it moves in either direction; a manual controller at each end of the car and an independent automatic control apparatus mechanically disconnected from the manual controllers but adapted to be electrically connected thereto, substantially as described.

31. An electric railway system embracing a track; a third rail on either side thereof; a car provided with two pairs of current collectors or shoes adapted to make contact in side pairs on either third rail; a motor at or near each end of the car; a manual controller for each motor; an automatic control apparatus including means for wholly interrupting the current flow to the motors; together with brake mechanism, said control apparatus being mechanically independent of or disconnected from the manual controllers, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHARLES J. KINTNER.

Witnesses:

M. TURNER,

M. F. KEATING.