S. D. McCALEB.

ELECTRIC TRACTION CONTROL SYSTEM.

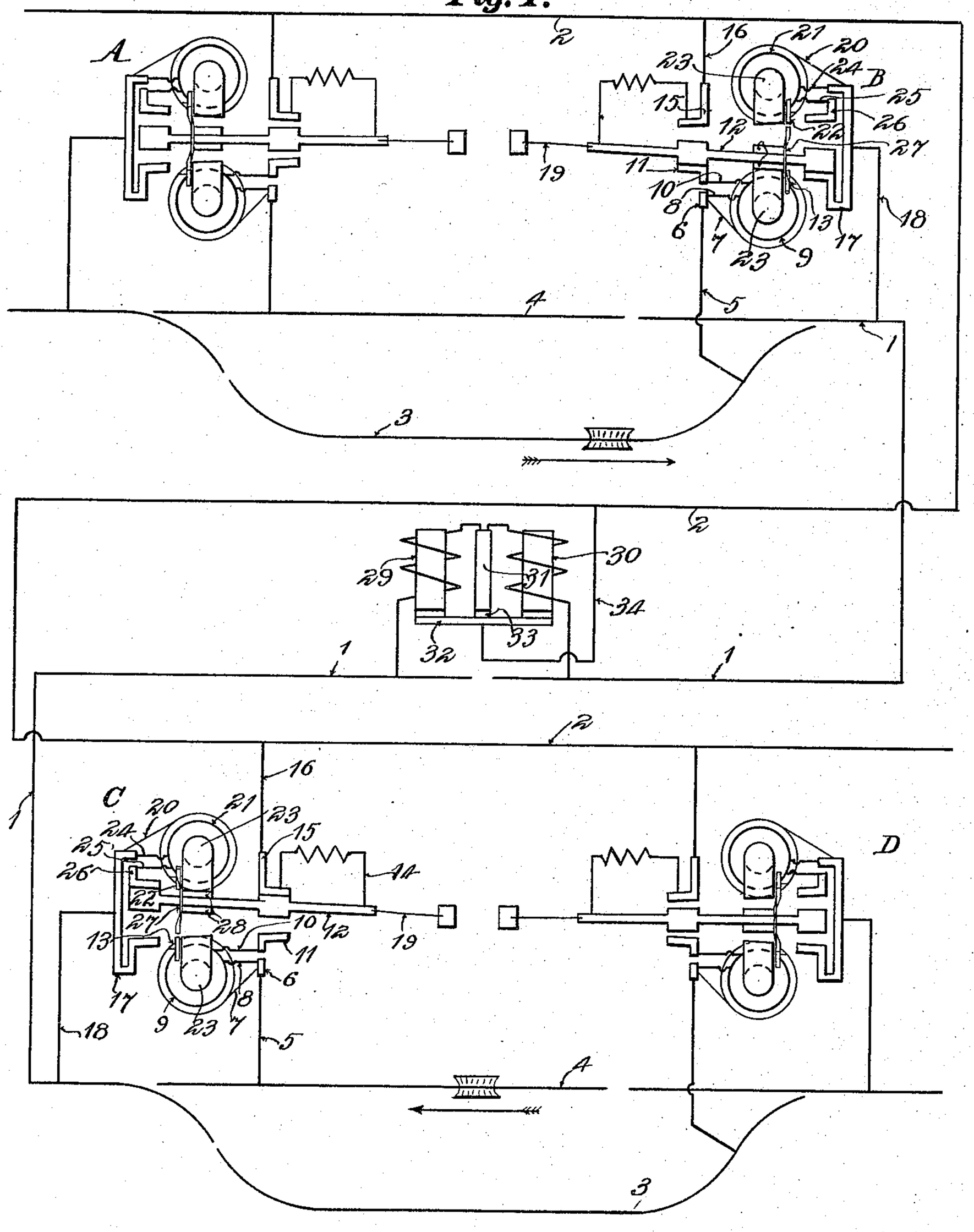
APPLICATION FILED JULY 29, 1912.

1,166,919.

Patented Jan. 4, 1916.

3 SHEETS—SHEET 1.

Fig. 1.



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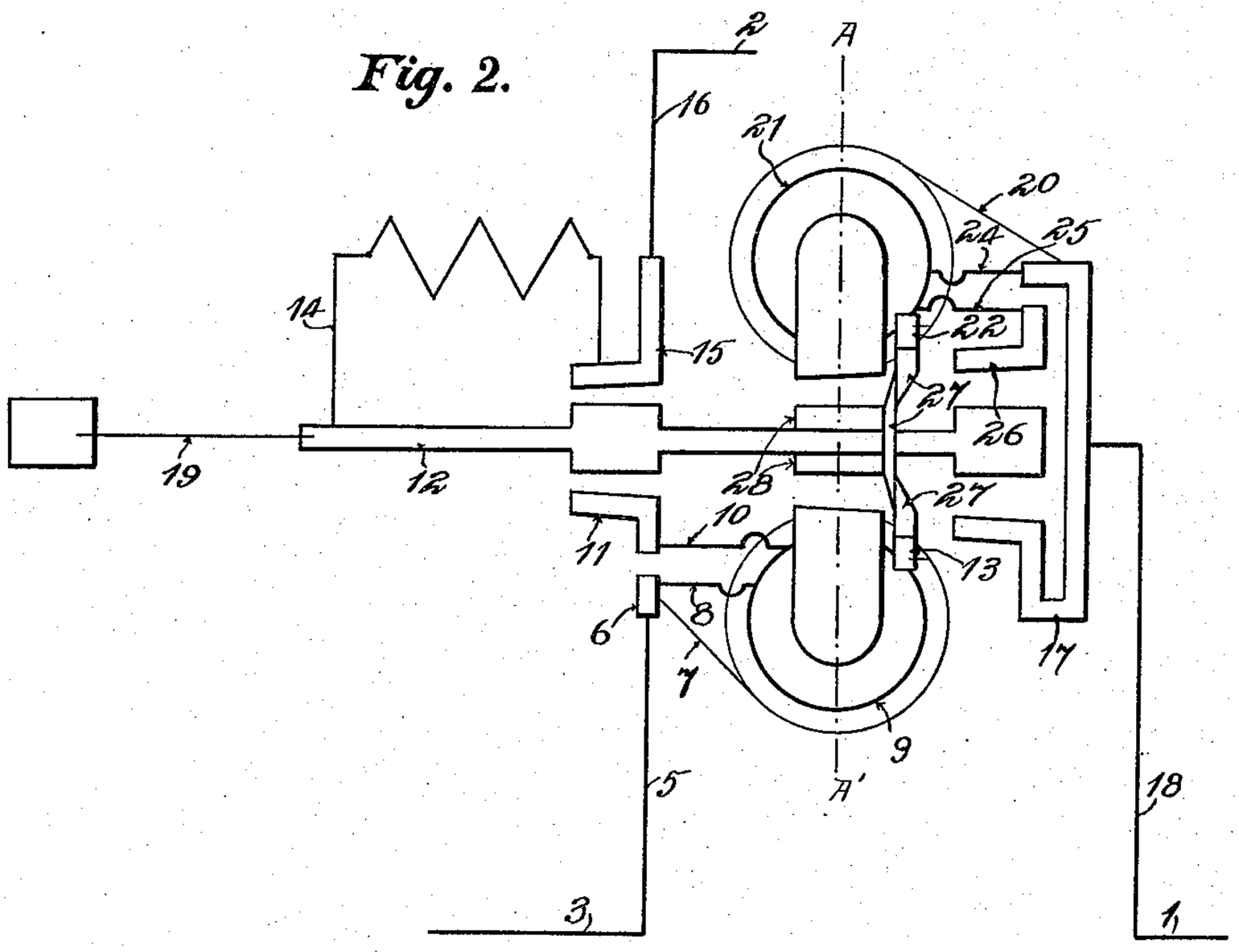
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

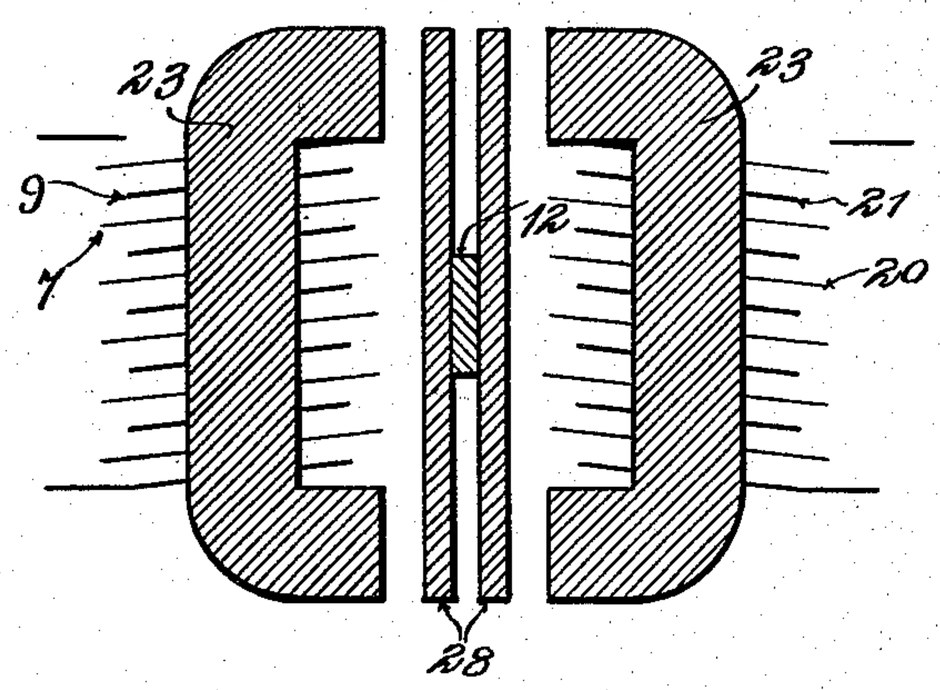


Fig. 4.

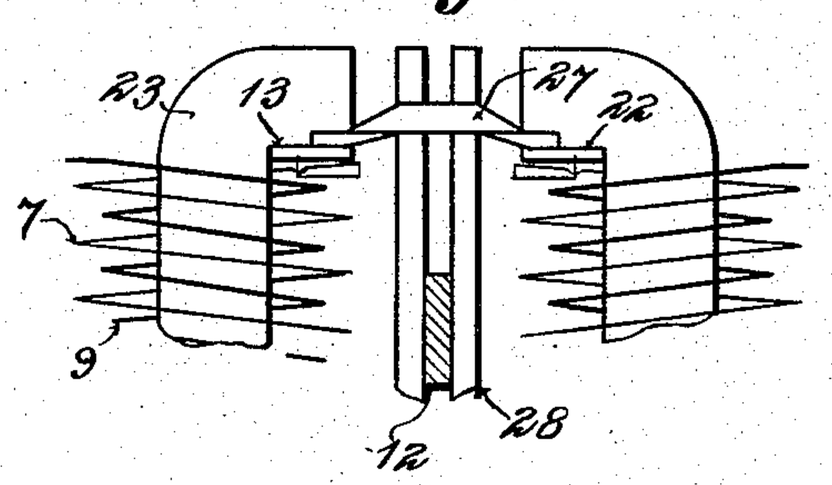
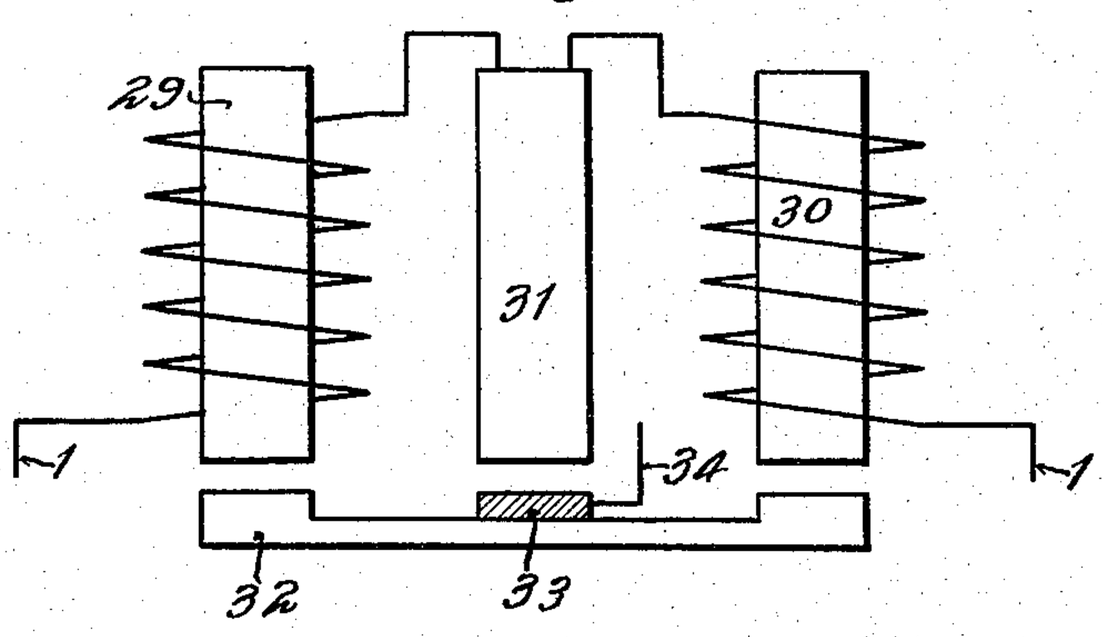


Fig. 5.



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UNITED STATES PATENT OFFICE.

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ELECTRIC-TRACTION-CONTROL SYSTEM.

1,166,919. Specification of Letters Patent. Patented Jan. 4, 1916.

Application filed July 29, 1912. Serial No. 712,013.

To all whom it may concern:

Be it known that I, SAMUEL DENNY McCALEB, a citizen of the United States, residing at Louisville, Jefferson county, Kentucky, have invented a new Electric-Traction-Control System, of which the following is a specification.

My invention relates particularly to single-track electric railway systems with the usual turn-outs or sidings and has for its object to provide improved means for preventing collisions.

A particular feature of my improvement consists in the elimination of all secondary control wires paralleling the main working conductor and in utilizing the said main conductor alone for the control of the safety devices.

A further feature of improvement consists in means by which a car in one of the single-track sections is enabled to take away operating control from cars in the siding behind as well as the siding ahead, thus avoiding rear-end as well as head-on collisions.

My invention includes certain novel features in the construction of the safety devices and the circuit connections of the same and various other features of improvements. I will now describe the means embodying my invention illustrated in the accompanying drawings and will thereafter point out the novel features in my claims.

In the accompanying drawings, Figure 1 is a diagram of the circuit connections of my system; Fig. 2 an enlarged view of one of the main control switches; Fig. 3, a vertical longitudinal section on the line A A′ of Fig. 2; Fig. 4, is an enlarged side view of one of the main control switches; and Fig. 5, an enlarged view of one of the intermediate tap switches.

Referring to Fig. 1 of the drawings there are shown the circuit connections and control devices for two consecutive turn-outs or sidings and the section of single track between them. The track rails which usually carry the return current to the power station in electric railway systems, are omitted from the drawings for simplicity, but the configuration of the main working conductor conforms with that of the rails. The siding at the top of Fig. 1 will hereafter be called the left siding, and the one at the bottom the right siding. The section of the main working conductor over the single track portion is separated electrically from the sections 3 and 4 for the left and right sidings respectively. The main working conductor 1 is engaged by the current collecting device on the car and supplies power current thereto for propelling the car. The feeder 2 supplying the main working conductor, carries the current from the power station and feeds the same to the sections of the main working conductor through magnetically operated main control switches A, B, C, D, which will be presently described.

At each siding there are two main control switches, one for controlling the single track section to the right and the other for controlling the single track section to the left. These will hereafter be called right and left switches respectively. The connections are similar at all sidings. Enlarged views of one of the main control switches are shown in Figs. 2, 3 and 4, which are respectively a plan view, a vertical section through the core and armature, and a side view. The switch is shown in conventional form and only enough parts are shown to make clear the functions of the switch. Details of construction have been omitted and form no part of the present invention. The switch is made up of the U shaped iron magnet cores or yokes 23, the solenoid windings 7 and 9, 20 and 21, which surround them, the movable iron armature 28 and the contacts 11, 12, 13, 15, 17, 22, 26 and 27. The windings 7 and 20 are made of fine wire with a large number of turns compared with the windings 9 and 21, which are made of heavier wire with a small number of turns. The windings 7 and 9 and one of the cores 23 constitute the electric magnet on one side of the armature 28, and the windings 20 and 21 and the other core 23 constitute the electro-magnet on the other side of the armature. The armature 28, made in two pieces, is within the influence of these two electro-magnets and is attracted in one direction or the other, according to which of the cores 23 is magnetized. The armature 28 is attached to the sides of a movable copper conducting bar 12, and is preferably insulated therefrom. It is obvious that the armature 28 can be made in one piece if desired. The

movable conducting bar 12 is pivoted at its outer end through a connection to a spring 19. The spring 19 holds the bar 12 in position between the two electro-magnets when neither of them is energized. In one direction the bar 12 makes contact with the stationary copper contacts 11 and 17, and in the other direction with stationary contacts 15 and 26. Attached to the contact bar 12, near its free end, is the auxiliary copper contact 27 which is also in electrical connection with the bar 12. The contact 27 is in engagement with both the stationary auxiliary copper contacts 13 and 22, when the bar 12 is in its open or middle position. The contact 13 is attached to one of the electro-magnets on one side of the bar 12 and the contact 22 to the other electro-magnet on the other side. As soon as the bar 12 moves to either side of its middle position, the contact 27 becomes disengaged from one or the other of the stationary contacts 13 and 22. One end of the fine wire winding 20 is connected to the auxiliary contact 22 and the other end to main contact 17. The end 8 of the heavy wire winding 9 is connected to stationary terminal 6 and the other end 10 to the main contact 11. The end 24 of the heavy wire winding 21 is connected to main contact 17 and the other end 25 to main contact 26. There is a resistance 14 between the contact bar 12 and main contact 15. The internal connections of the switch just described are the same for all the siding switches.

The operation of the system will now be described, and reference should be had particularly to Fig. 1. Assume that a car has entered the left-hand siding before one enters the right-hand siding. The cars are represented in the drawing by trolley wheels and their directions of travel are indicated by the points of the arrows directly below them. Assume also that the right switch B of the left siding, and the left switch C of the right siding are in their open or mid-positions. As soon as the trolley at the left-hand siding comes in contact with the section 3 of the main conductor, the following circuit is established: From the feeder 2, through wire 16 to contact 15 of the right switch B of the left siding, through resistance 14 to contact bar 12, to sliding contact 27, to contact 13 through fine wire coil 7 to terminal 6, through wire 5 to section 3 of the main conductor, to the trolley on the car in the left siding and through the motors or other translating devices on the car to the ground. The flow of current through the above circuit energizes the fine wire coil 7 and the electro-magnet core 23 which it surrounds is magnetized. On account of the high resistance of the coil 7, and the resistance 14, this current is not large enough to turn the motors on the car. It is merely a controlling current for the siding switch. The energization of the coil 7 causes the contact bar 12 to be pulled toward it until the bar 12 engages main stationary contacts 11 and 17, the latter slightly in advance of the former. This is the position in which it is shown in Fig. 1. The sliding contact 27 still engages contact 13, but is now out of engagement with contact 22. As soon as the bar 12 engages the contact 17 of the switch B of the left siding, the switch C of the right siding is energized from the feeder 2 back through the working conductor 1 and through the switch B to the trolley on the siding 3. The new circuit is as follows: from feeder 2 to wire 16 of the left switch C of the right siding, to resistance 14, to bar 12, to sliding contact 27 and contact 22, through fine wire winding 20 to contact 17, to conductor 1, to wire 18 of the right switch B of the left siding, to contact 17, to contact bar 12 to sliding contact 27, to contact 13, through fine wire coil 7 to terminal 6, to wire 5, to conductor 3, and through the car in the left siding to the ground. The part of the control current which passes through the circuit just described causes the contact bar 12 of the left switch C of the right siding to be pulled to the position which it occupies in Fig. 1. As soon as the switch C and the right switch B of the left siding are in their final closed position as shown in Fig. 1 it will be seen that the fine wire coils 20 and 7 in the two switches are shunted respectively by the heavy wire coils 21 and 9. On account of the low resistance of these heavy wire coils compared with that of the fine wire coils and the resistances 14, practically no current will now flow through the fine wire coils nor through resistances 14 and the current to the car in the left-hand siding will now come only by way of conductor 1 through the following circuit: from feeder No. 2 through wire 16 of the left switch C of the right siding, to contact 15, to movable bar 12, to contact 26, through wire 25 to heavy wire winding 21 and by wire 24 to contact 17, to wire 18, through conductor 1 to wire 18 of the right switch B, of the left siding, to contact 17, through the movable bar 12 to contact 11, by wire 10 through heavy wire winding 9 and by wire 8 to terminal 6, through wire 5 to conductor 3 and through the car in the left siding to the ground. The resistance of this circuit is low enough to permit the motors on the car to operate and to propel the car and at the same time this current powerfully magnetizes the left and right siding switches C and B just described and holds them in the position shown in Fig. 1. The car in the left siding 3 now continues to the right and enters the single track section under the conductor 1. At the same time it is impossible for the car in the right siding 4 to continue

to the left since the left switch C of that siding is locked against it; that is, the sliding contact 27 is out of engagement with the contact 13. There is therefore no way for the car in the right siding to get power from the conductor 4 which is, for the time being, dead. The car in the left siding now reaches the single track section, and the current collecting device or trolley comes in contact with the conductor 1. In passing from the conductor 3 to the conductor 1 there is a momentary break in the circuit through the motors and the two control switches which have been closed open for an instant but are immediately closed again when the trolley comes in contact with the conductor 1. The left hand switch C of the right siding is thrown to the same position it occupied an instant before but the right switch B of the left siding is now closed in the opposite direction. Consider the instant of time when the switches are opened and the car reaches the conductor 1: The control current is now supplied to the conductor 1 from similar paths through both switches mentioned, namely, from the feeder 2 through the wires 16, through the resistances 14, through the conducting bars 12, the sliding contacts 27, the contacts 22, the fine wire coils 20, the contacts 17 and the wires 18. The contact bars 12 are therefore drawn toward the coils 20 until they finally come in contact with the contacts 15 and 26 in both switches. This action again causes the fine wire coils to be shunted by the heavy wire coils 21 and the power for propelling the car is now supplied through the following path through both of these switches, the two paths being in parallel: from feeder 2 through wire 16 to contact 15, through conducting bar 12 to contact 26, through wire 25, through heavy wire coil 21, through wire 24 to contact 17, through wire 18 to conductor 1 and through the car to the ground.

The car from the left siding continues to travel to the right toward the right siding and the power current through the left switch of the right siding continues to deprive the car in the right siding of power. It will be noticed that the power current which is drawn through the right switch of the left siding prevents a car which has entered the left siding and traveling in the same direction as the car in the single track section from following this car, for the conductor 3 is now deprived of power inasmuch as the sliding contact 27 is no longer in engagement with the contact 13. Thus there is a protection against rear-end as well as head-on collisions. When the car from the left siding reaches the right hand section it passes around the car waiting there under conductor 4 at that siding. It can then continue to the right along the succeeding single track section provided no car has entered that section from either direction. The car in the right siding can now continue to the left provided no other car has entered the single track section to the left of it and it will control the switches at either end of the single track section in the same manner that the car from the left siding controlled these switches except that the direction of closing will be reversed in the two switches; that is, when the car draws power from the siding conductor 4 the left switch C of that siding will be thrown toward the coil 7 and the right switch B of the left siding will be thrown toward the coil 20 and when the car enters the single track section the switch behind it will be thrown oppositely toward the coil 20 while the right switch of the left siding will be thrown to the same position as before, namely, toward the coil 20. Thus the car traveling toward the left will deprive the conductors 4 and 3 of power while in the single track section. When a car is on the single track a control of the switches protecting the sections may be secured during the intervals when the car is brought to a stop and the motors shut down, in a number of ways, one of which is to provide a by-pass for the control current, through a resistance, lights or other device on the car. This by-pass may be established by the motor controller at each stop, but the precise method is wholly within the choice of the user.

Where the single track sections 1 of the main conductor are comparatively long I may provide intermediate tap connections from the feeder, to compensate for voltage drop along these sections. Fig. 5 shows in detail one way in which these taps from the feeder may be automatically connected to the single track sections 1 at certain times, while Fig. 1 shows such arrangement combined in the general system. It consists of electromagnetic switches which require comparatively heavy current for their operation. Referring to Figs. 1 and 5 the magnets 29 and 30 are connected in series across a break in the conductor 1. When a car is a sufficient distance from a siding to draw current enough through the magnets 29 and 30 to attract the iron shoes 32, the contact 33 engages with the contact bar 31 and the feeder tap 34 is connected to the junction between the solenoids 29 and 30. A feeder connection is therefore established to the conductor 1 on each side of the break through the solenoids 29 and 30 respectively, and this connection is maintained until the current is reduced through the solenoids 29 and 30, as the car moves toward one of the sidings.

I do not limit myself to the exact form in which my invention is herein disclosed as it is obvious that various modifications might be made in the construction shown in the

drawings and above particularly described without departing from the spirit and scope of my invention.

What I claim and desire to secure by Letters Patent is:—

1. In a single-track electric railway with turn-outs, the combination of a working conductor, a feeding conductor and control switches at the turn-outs, and means for controlling the admission of current to the single-track sections and turn-outs, said means consisting of the said working conductor, the said feeding conductor, the said control switches and the car having the right of way on said railway.

2. A single-track electric railway, with turn-outs, two main control switches at each turn-out, one for controlling the admission of current to one turn-out track and the single track section to the right, and one for controlling the admission of current to the other turn-out track and the single track section to the left, such switches being operated in accordance with the position of the car having the right of way to protect such car from rear-end and head-on collisions.

3. In an electric railway system the combination of single track sections and turn-outs, instrumentalities for supplying power to a single track section and means controlled by such instrumentalities for taking away electric current from one side of each of the turn-outs at the ends of the single track section.

4. In an electric railway system the combination of single track sections and turn-outs, a working conductor divided into sections corresponding to the single track sections and turn-outs, and means for depriving conductor sections of two sidings of electric current when power is being taken from the single track conductor section between them.

5. A single track electric railway system with turn-outs, the combination of a working conductor divided into sections, electro-magnetic switches at the ends of a single track conductor section, having two operating positions, one for supplying power to said section and simultaneously depriving the turn-outs at each end thereof of power, and the other for supplying power to either of said turn-outs and simultaneously depriving the other turn-out of power.

6. In an electric railway control system, the combination of a single tack railway with turn-outs, a working conductor divided into sections corresponding to the sections of single track and the turn-outs, and switches which connect the turn-out conductors with the source of power by way of the single track conductors and the switches at adjacent turn-outs and which connect the single track conductors with the source of power by way of the single track conductors and the switches at both ends of such conductors.

7. In an electric railway control system, the combination of a single track railway with turn-outs, of a working conductor divided into sections corresponding to the sections of single track and each of the turn-out tracks, electro-magnetic means controlled by the current passing to a turn-out for depriving an adjacent turn-out of power and means controlled by the current passing to a single track section for depriving the turn-out at each end thereof of power.

8. In an electric railway control system, the combination of a single track railway with turn-outs, a working conductor divided into sections corresponding to the sections of single track and each of the turn-out tracks, electro-magnetic switches at the turn-outs for depriving a car entering a turn-out of power to go ahead when another car has entered or is about to enter the single track section ahead of it, controlling means for the switches, means whereby current delivered to a turn-out passes through the working conductor of the single track section ahead of it and through the controlling means for the switch at the other end of said section, and means whereby current delivered to a single track section passes through the controlling means for the turn-out switch at each end thereof.

9. In an electric traction system the combination of a working conductor divided into sections and means at adjacent ends of two consecutive sections for supplying current through practically the entire length of one section to a car at the remote end thereof and for simultaneously depriving the other section of power control, said means being controlled by said current.

10. An electric railway with a working conductor divided into sections, the combination with a feeding conductor supplying current at each end of such sections of electro-magnetic means controlled by the current supplied to the car for feeding current to the section of working conductor at one or more intermediate points.

11. In an electric railway system, the combination with single track sections and turn-outs, of a working conductor divided into sections, electro-magnetic switches at the turn-outs which are operated by the current passing to a car, said switches being adapted to deprive cars going in either direction of power to enter a single track section when another car is on such single track section and to deprive cars at one turn-out of power to enter a single track section when a car going in the opposite direction first reaches the turn-out at the other end thereof.

12. A protective system for electric railways having single track sections and turn-outs, a working conductor divided into sec-

tions corresponding thereto, electro-magnetic switches located at or near both ends of such sections for controlling the admission of current to such conductor sections, each of said switches normally occupying a neutral position but capable of being thrown to either of two operating positions depending upon the position of the car having the right of way.

13. In an electric railway system having single track sections and turn-outs, a working conductor divided into sections corresponding thereto, electro-magnetic switches located at or near both ends of such sections for controlling the admission of current to such conductor sections, each of said switches biased to normally occupy a neutral position between two operating positions and having two sets of auxiliary contacts which are closed in the neutral position but one or the other of which is open in an operating position, and having two sets of main contacts, both of which are open in the neutral position of the switch but one or the other closed in an operating position, and having an armature and a high-resistance and a low-resistance magnet winding on each side of the armature for operating the same, the high resistance coils being connected to the auxiliary contacts and the low-resistance coils being connected to the main contacts, the switch being adapted to be closed by one or the other of the high-resistance windings and maintained closed by the corresponding low-resistance winding.

14. In a protective system for electric railways having single track sections and turn-outs, a working conductor divided into sections corresponding thereto, a feeder, electromagnet switches located at or near both ends of each single track conductor section for controlling the admission of power current to such section, each of the switches normally occupying a neutral position but capable of being thrown to either of two operating positions, two sets of high and low resistance magnet windings for the switches corresponding to the two operating positions thereof, one of the high-resistance windings being in series with a siding conductor section and the feeder and the other in series with one of the adjacent single track conductor sections and the feeder when the switch is in the neutral position, and one of the low-resistance windings being in series with the adjacent single track conductor section and a siding conductor section when the switch is in one operating position and the other low-resistance winding being in series with the adjacent single track conductor section and the feeder when the switch is in the other operating position.

15. In an electric railway control system, the combination of a single track railway with turn-outs, a working conductor divided into sections corresponding to the sections of single track and each of the turn-out tracks, electro-magnetic switches at the turn-outs for depriving a car entering a turn-out of power to go ahead when another car has entered or is about to enter the single track section ahead of it, controlling means for the switches, and means whereby current delivered to a turn-out passes through the working conductor of the single track section ahead of it and through the controlling means for the switch at the other end of said section.

16. A single track electric railway system with turn-outs, two control switches at each turn-out, one of said switches controlling the current to one track of said turn-out, to the single track section to the right and to one of the tracks of the turn-out at the opposite end of said right-hand single track section and the other of said switches controlling the current to the other track of the said first turn-out, to the single track section to the left and to one of the tracks of the turn-out at the opposite end of said left-hand single track section, such switches being operated in accordance with the position of the car having the right of way.

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Witnesses:
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