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W. B. POTTER.

ELECTRIC RAILWAY SYSTEM.

APPLICATION FILED APR. 3, 1900.

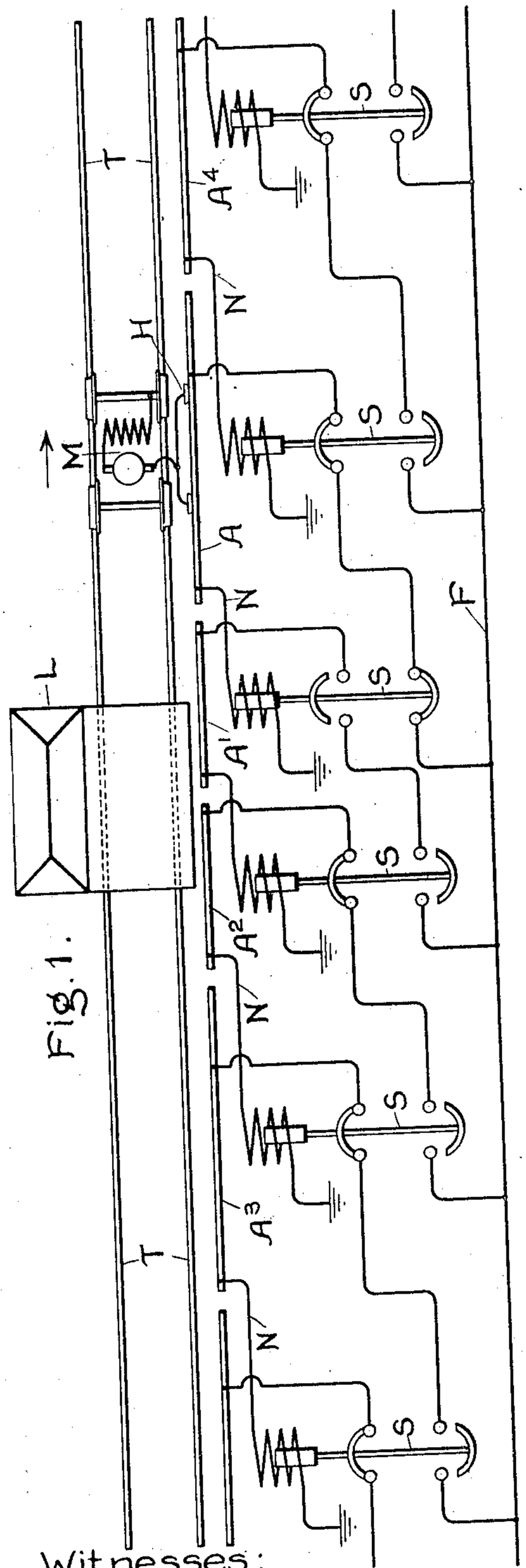

Fig. 1.

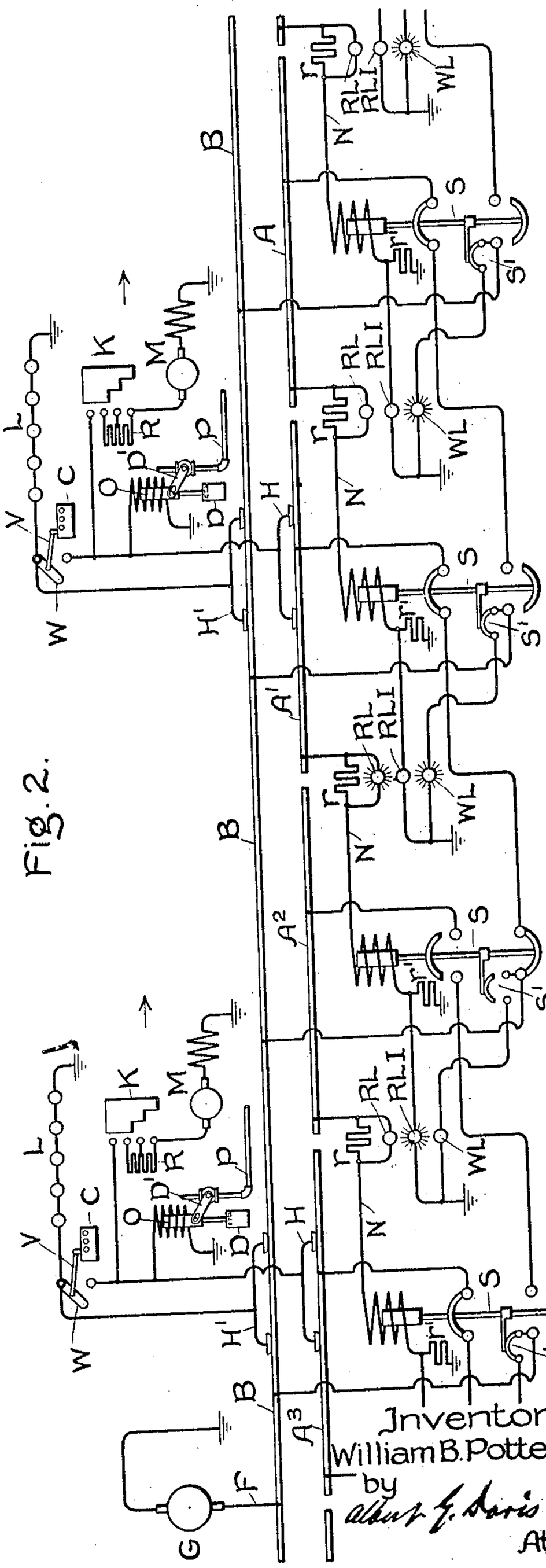

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ELECTRIC-RAILWAY SYSTEM.

No. 869,459. Specification of Letters Patent. Patented Oct. 29, 1907.

Application filed April 3, 1900. Serial No. 11,405.

To all whom it may concern:

Be it known that I, WILLIAM B. POTTER, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric-Railway Systems, of which the following is a specification.

This invention relates to sectional electric railway systems provided with means for preventing trains from approaching nearer to each other than the length of a section, and to improvements in braking and signaling especially adapted to such system, but applicable to other systems.

Figure 1 is a diagrammatic illustration of a railway constructed in accordance with my invention; and Fig. 2 is a similar illustration of the same railway with additional improvements embodied therein.

In Fig. 1 the track rails are represented by T, and may serve as the return conductor. The motor M carried by the car, is connected with the shoe H, which engages with the normally dead sectional working conductors A, A′ etc. The sections of the working conductor are of considerable length with respect to the length of the car or train, and are proportional in length to the speed which would be generally maintained by the train, while it is passing over a given section. Means are provided whereby a train causes the section over which it is passing to become energized, and prevents the dead section over which it has just passed, from being energized by a following train. Thus the following train enters upon a section behind the advance train, which is of relatively great length, and which the following train is unable to energize, so that it will stop, and more quickly since brakes are provided which are set automatically when the train enters the dead section. An auxiliary working conductor is provided, so that the operator can cause the train to move over the dead section, when desirable. A system of signals is also provided.

In Fig. 1 the sections are shown shorter in the vicinity of the station L, where the trains will usually slow down. At other portions of the road, as on grades, on an air line between stations, or in any other place where high speed would be maintained, they would be of greater length. For example, in certain portions of the road, it might be desirable that a section be as long as a mile and a half. In any event, the lengths of the sections at different parts of the road will be determined by engineers in accordance with prevailing conditions.

An electro-magnetic switch S is provided for each section, to control the supply of current thereto from the feeder. The connection between each section and the feeder is broken in two places, and each switch controls one break in each of the two connections from two successive sections to the feeder. Each switch in its normal position closes one break in one connection and maintains the break in the other connection open. In Fig. 1 the arrow indicates that the car is proceeding to the right. Since the collector bridges the sections A′ and A, and the upper break in the switch of the section A′ remains closed until the collector engages the section A, the shoe H will close a new circuit as soon as it engages with the section A. The shoe H, having engaged with the section A, has completed the circuit through the ground shunt N, which includes the coil of the switch of the section A′. Thereupon that switch has been raised to open the upper break and close the lower one, so that current is now flowing through the portion of the switch which closes the lower break, and the portion of the advance switch which closes the upper break in the connection of the section A, so that current is flowing from the feeder through the section A and shoe H, to the car motor and track return. The upper break in the feeder connection of the rear section A′ is held open until the shoe has passed entirely from the advance section A, so that it will be impossible for a following train to close the feeder connection of the rear section A′, while the advance train is on the section A. The following train will close the first and lower break in the feeder connection of the rear section A′, but since the second and upper break is held open while a train is on the section A, instead of being closed as it is normally when the track is clear, the following train cannot cause that section A′ to be energized, until the section A is clear.

In the upper portion of Fig. 2 are shown two groups of apparatus which represent single cars, or the master cars of a train. The shoe H travels along the conductor A, A′ etc., as in Fig. 1, and is connected with the controller K, which coöperates with the resistance R to regulate the car motors, one only of which is shown for the purpose of illustration. The return circuit may be through the track rails as shown in Fig. 1, the rails being omitted in Fig. 2 for the sake of clearness. An auxiliary continuous working conductor B is permanently connected to, or may serve as, the feeder, which is supplied with current from the generator G. A shoe H′ travels along this auxiliary working conductor, and normally supplies current independently of the shoe H to lamps, the air compressor motor, or other desired translating device on the car or train. A switch W is provided whereby the conductor B may be connected with the controller K when it is desired to operate the car motors from the conductor B. This may be at any time when the current fails in the sectional conductor, but the arrangement is especially adapted to be used when the following train, such as the one shown at the left in Fig. 2, enters upon a section such as A^2, which is maintained disconnected from the feeder by the ad-

vance train, as described above. Also, since the arrangement of the electro-magnetic switches prevents the train from moving backwards, the section behind the train being dead until the shoe has cleared the section under the train, the conductor B may be connected by the switch W with the controller when it is desired to back the train to the left for any reason.

Since the operation of the car motors by current received from the conductor B is not normal, a counter or registering apparatus C is connected to the switch W by means of the link V in order to record the number of movements of the switch. As this switch is preferably only used in emergency cases, the said registering apparatus serves as a check on its use.

Means for automatically setting the brakes when the train reaches a section held dead by a preceding train, are provided, as follows: A coil O carried by the car is connected between the shoe H and ground forming a movable branch of the power-circuit, and is adapted to operate a link D′ which controls a valve in an air brake pipe P. Thus when the train enters upon a section A^2 which cannot be caused to be energized by the train, while a train is on the section A′, current will fail in the coil O which normally maintains a valve closed, so that the valve will automatically open and permit the brakes to be set. A suitable retarding device, such as a dash pot D serves to retard the effect of the action of the coil, in order to prevent the valve from opening upon the momentary fluctuations in the current flowing through the coil. If electric brakes are used, it is intended that the coil O shall be adapted to operate the switch which makes connections to set the brakes. The coil O, may if it is desired, be connected with the shoe H′ instead of the shoe H, in the system shown in Fig. 2, in order to avoid the fluctuations of current, but for the specific purpose of braking a train entering upon a dead section, the coil O should be connected to the shoe H as shown.

In order to indicate to the operator of the following train the condition of the advance sections and the position of an advance train, a system of electrically operated visual signals is provided, which may comprise electric lamps for night work and electrically operated semaphores for daylight. A safety signal WL, which may be white for example, is located at the beginning of a section such as A, and so connected that it will be continuously operated, during the time that the section next in advance of the section A is dead, and in such condition that it may be caused to be energized by an advancing train. Each safety signal WL is connected in a shunt from the conductor B or the feeder to ground. The electro-magnetic switches S each carry a switch S′, which, when the switches S are in their normal lower position, as shown beneath the section A, close a break in said ground shunt. When the train enters upon a section A′, the switch S, shown beneath the section A^2, is raised and causes the switch S′ to break the circuit of a signal WL, at the beginning of the section A^2. The signals in operation under the condition existing as shown in Fig. 2, are indicated by the radial lines.

Grouped with the signal WL at the beginning of each section such as A, are the signals RL and RLI, which may be red, for example, in color. The operation of the signal RL, which coöperates with the signal WL of the same group to form a danger signal, may be seen in connection with the group beneath the beginning of section A′. The signal is shown in parallel with a resistance r in the circuit from the section A′, which for example may be through the coil of the switch S for the section A^2. When the train enters the section A′, the signal RL will be actuated, and will continue to indicate to the operator of the following train, that the advance train is on that section, until the advance train leaves the section. The operation of the caution signal RLI will be seen in connection with the group shown at the beginning of the section A^2. The signal is shown in parallel with the resistance r' in a circuit which for example, includes the coil of the switch S for the section A^2. When a train is as shown, upon the section A′, the caution signal RLI will be operated to indicate to the operator of the following train that a train is on the section A′ next in advance of the section A^2 upon which his train is about to enter. In this group the signal RL is inoperative, since the advance train has passed from the section A^2 to the section A′, and the safety white signal WL is inoperative because the train upon the section A′ has caused the switch S′ to move the switch S′ to break its circuit.

What I claim as new and desire to secure by Letters Patent of the United States, is,

1. In a safety sectional conductor a block electric railway system, the combination with the feeder, of a sectional conductor the sections of which are of great length with respect to the railway vehicle and are normally disconnected from said feeder, a plurality of switches adapted to close the circuit between the feeder and the section over which the train is passing and to keep the circuit open between the feeder and the section next adjacent to the section over which the train is passing, and a plurality of electromagnets for actuating said switches connected in a circuit between the sections of said sectional conductor and the return.

2. In a safety sectional conductor block electric railway system, the combination with the feeder, of a normally dead sectional working conductor the sections of which are of great length with respect to the railway vehicles, a branch between each section and the feeder, which is broken in two places, and a plurality of double-acting electromagnetic switches each of which normally closes one break in one branch and when actuated opens at that break in that branch and closes a break in a next adjacent branch.

3. In a safety sectional conductor block electric railway system, the combination with the feeder, of a normally dead sectional working conductor the sections of which are of great length with respect to the railway vehicle, a branch between each section and the feeder, which is broken in two places, a plurality of double-acting switches each of which normally closes one break in one branch and when actuated opens at that break in that branch and closes a break in a next adjacent branch, and a plurality of magnet coils each of which is connected between a sectional conductor and the return and controls one of said switches.

4. In an electric railway system, the combination with the feeder, of a normally dead sectional working conductor, a plurality of electromagnetic switches adapted to close the circuit between the feeder and the section over which a train is passing and to keep the circuit open between the feeder and the section behind the section over which the train is passing, an auxiliary continuous service conductor permanently connected with the feeder, and independent collectors engaging said conductors and connected to the translating devices carried by the car.

5. In an electric railway system, the combination with the feeder, of a normally dead sectional working conductor, an auxiliary continuous service conductor per-

manently connected with the feeder, independent collectors engaging said conductors and connected to translating devices carried by the car, and a plurality of electromagnetic switches adapted to close the circuit between the auxiliary conductor and a section over which a train is passing and to keep the circuit open between the auxiliary conductor and the section behind the section over which the train is passing.

6. In an electric railway system, the combination with the feeder, of a normally dead sectional conductor, switches for connecting said feeder to the sections of said conductor, an auxiliary continuous service conductor permanently connected with the feeder, electrically independent collectors carried by the car for each conductor, a controller connected through one collector with the sectional conductor, and a switch for connecting the controller with the collector which engages the continuous conductor.

7. In an electric railway system, the combination with the feeder, of a normally dead sectional conductor, an auxiliary continuous service conductor permanently connected with the feeder, electrically independent collectors carried by the car so as to engage the respective conductors, and switches to connect the auxiliary conductor with the section of the sectional conductor over which the train is passing for the purpose of supplying current to the said sectional conductor.

8. In an electric railway system, the combination with a source of current supply, of a sectional conductor, an auxiliary continuous conductor connected with the source of current supply to normally supply translating devices on the car other than the motors, car motors, electrically independent collectors carried by the car for engaging independently the sectional and auxiliary conductors, a connection between the car motors and the collector engaging with the sectional conductor, electromagnetic switches for connecting the sections of the sectional conductor with the source of current supply, and a switch for connecting the collector engaging the auxiliary conductor with the car motors so that the latter can be supplied with current from said auxiliary conductor.

9. In an electric arilway system, the combination with a source of current supply, of a sectional working conductor, normally-open switches for connecting the sections of said sectional conductor to the source of current supply, car motors normally operated by current taken from said sectional conductor, an auxiliary continuous conductor permanently connected with the source of current supply and normally supplying translating devices on the car other than the motors, two electrically independent collecting devices carried by the car and coöperating with the respective conductors, and a switch for connecting the car motors and the collecting device which coöperates with the auxiliary conductor, whereby the motors can be operated by current from said auxiliary conductor.

10. In an electric railway system, the combination with a source of current supply, of a normally dead sectional working conductor, car motors normally operated by the current taken from said sectional working conductor, an auxiliary continuous conductor permanently connected with the source of current supply and normally supplying translating devices on the car other than the motors, two electrically independent collecting devices carried by the car and coöperating with the respective conductors, a switch for connecting the car motors to the collecting device which coöperates with the auxiliary conductor, whereby said motors can be operated by current from the auxiliary conductor, and a recording mechinism operated by said switch.

11. In an electric railway system, the combination with a source of current supply, of a normally dead sectional working conductor, connections between the source of current supply and the sections of said conductor, electromagnetically-actuated switches controlling said connections and constructed and arranged so that when the actuating coils of said switches are energized the section over which the train is passing is connected to the feeder and the section over which the train has just passed is disconnected from the feeder and is thereby prevented from becoming energized when a following train enters the last-mentioned section, a permanently energized auxiliary continuous conductor, two electrically independent collecting devices on the train coöperating with the respective conductors, and a switch for connecting the car motors with the collector which engages the continuous conductor, whereby the motors can be operated by current from said continuous conductor.

12. In an electric railway, the combination with a source of current supply, of an auxiliary continuous conductor arranged as a feeder and connected with said source of supply, a sectional service conductor, electromagnetic switches for connecting the sections of said sectional conductor with the continuous conductor, a car collector engaging said sectional conductor, a car collector engaging said continuous conductor, translating devices carried by the car, and a switch for connecting said translating devices with either collector.

13. In an electric railway system, the combination with the working conductor, of a car or train, an air-brake system therefor, a valve controlling the operation of the brakes, a coil controlling said valve, means for retarding the operation of said valve, and a collector connected with the coil and adapted to engage with the working conductor, whereby the valve is held closed and the brakes released while the conductor is energized.

14. In an electric railway system, the combination with the working conductor, of a train operated therefrom, a braking system for the train, means tending normally to operate said braking system to cause the brakes to be applied, electromagnetically-controlled means for preventing the setting of the brakes except when current fails in the working conductor, and means for instituting a time limit in the operation of said braking system to prevent the setting of the brakes by fluctuations of the current in the working conductor.

15. In an electric railway system, the combination with the working conductor, of a train, air-brakes therefor, a valve, means normally tending to operate the valve to apply the brakes, an electromagnet coil connected with the working conductor for holding the valve closed while the conductor is energized, and a dash-pot for instituting a time limit in the action of the valve-opening means.

16. In an electric railway system, a car or train, driving motors therefor, a source of current for said driving motors, a braking system, electrically operated controlling means for the brakes energized from said source and adapted to apply the brakes upon a deënergizing of said source, and means for retarding the application of the brakes.

17. In an electric railway system, a car or train, driving motors therefor, a supply circuit for said motors, a braking system, a magnet winding connected to said supply circuit, means controlled by said magnet adapted to apply the brakes when said magnet is deënergized, and means for retarding the application of the brakes.

18. In an electric railway system, the combination with a normally dead sectional conductor having sections of different lengths, the lengths of said sections being proportional to the speed at which the train will commonly proceed over a given section, of electromagnetically-controlled means for causing a section over which a train is passing to be energized and for preventing the dead section over which it has just passed from being caused to be energized by a following train.

19. In an electric railway system, the combination with a normally dead sectional working conductor, of electromagnetically-actuated means located at intervals along the road-way, for causing the section of the sectional conductor over which a train is passing to be energized and for preventing the dead section over which it has just passed from being caused to be energized by a following train, and means controlled by said electromagnetically-actuated means for indicating visually to the operator of a train at the beginning of a section the fact that the condition of the section is normal.

20. In an electric railway system, the combination with a normally dead sectional working conductor, of electromagnetically-controlled means for causing the section over which a train is passing to be energized and for preventing the dead section over which it has just passed from

being caused to be energized by a following train, means for indicating visually at the beginning of such latter section to the operator of the following train the fact that his train is about to enter the section behind the section over which the advance train is passing, and a branch circuit from the section over which the advance train is passing for controlling said indicating means.

21. In an electric railway system, the combination with a normally dead sectional working conductor, of electromagnetically-controlled means for causing the section over which a train is passing to be energized and for preventing the dead section over which it has just passed from being caused to be energized by a following train, auxiliary means whereby the following train can be propelled over such latter section, means for indicating visually at the beginning of such latter section to the operator of the following train the fact that his train is about to enter the section over which the advance train has just passed, and a branch circuit from the section over which the advance train is passing, for controlling said indicating means.

22. In an electric railway system, the combination with a normally dead sectional working conductor, of electromagnetic switches which are successively actuated as a car or train proceeds, to energize said sections, electrically operated signals connected in circuits which are closed while the conductor sections are dead, and means connected with said switches for opening the circuits of said signals when the switches are actuated to energize said sectional conductor.

23. In an electric railway, the combination with a normally dead sectional working conductor, of electromagnetic switches which are successively actuated as a car proceeds, to energize said sections, an electrically operated signal connected in circuit with one of said switches and located at the beginning of a section, the circuit connections of said signal being such that the signal is operated by said switch when the latter is actuated by the passage of a car over the next advance section.

24. In an electric railway, the combination with a normally dead sectional working conductor, of electromagnetic switches which are actuated as a car proceeds, to energize said sections, an electrically operated signal connected in circuit with said switches and located at the beginning of a section, the circuit connections of said signal being such that the signal is operated by said switch when the latter is actuated by the passage of a car on said section.

25. In an electric railway system, the combination with a normally dead sectional working conductor, of electromagnetic switches the actuating coils of which are energized to actuate said switches as a car proceeds, to energize said sections, electrically operated visual signaling-means connected in circuit with one of said switches, the circuit connections being such that the signaling-means is supplied with current by the actuation of said switch by an advance train, so that the presence of such train is indicated to the operator of a train on a section immediately in the rear of the advance train.

26. In an electric railway, the combination with a normally dead sectional working conductor, of electromagnetic switches the actuating coils of which are energized to actuate the switches to cause said sections to be successively energized as a car proceeds, an electrically operated signal for a section connected in a circuit which is normally closed by the switch of said section in the closing position of the switch, and a second electrically operated signal for said section connected in circuit with said section, the circuit of said second signal being closed when said section is energized, said signals coöperating to indicate to the operator of a following train the presence of a train on the section to which the signals belong.

27. In an electric railway system, the combination with the feeder, of a normally dead sectional working conductor, an electrically operated safety signal located at the beginning of each section, a switch normally closing a connection between the feeder and said signal, an electromagnetic switch for connecting the feeder and a conductor section, and means connecting said normally closed switch with the electromagnetic switch whereby the circuit of the signal is opened when the electromagnetic switch is actuated to energize the conductor section.

28. In an electric railway system, the combination with the feeder, of a normally dead sectional working conductor, electromagnetic switches for connecting the sections with the feeder, electrically operated visual signals, and normally closed switches therefor controlled by the electromagnetic switches for maintaining the circuit to the signals closed while the electromagnetic switches are in their normal position.

29. In an electric railway system, the combination with a normally dead sectional working conductor, of an energizing switch for each section thereof, means for operating the switch of the next rear section to energize a certain section when the train passes on to said last-mentioned section, an electrically operated safety signal normally operating at the beginning of the rear section, and a switch for the signal, which is controlled by the energizing switch of the rear section and is opened when the latter is operated by the train.

30. In an electric railway system, the combination with a normally dead sectional working conductor, of an electromagnetic energizing switch for each section thereof, and electrically operated safety and danger signals controlled by said switch, the safety signal being cut out when the switch is operated and the danger signal being operated while the coil of the switch is energized.

31. In an electric railway system, the combination with a normally dead section working conductor, of electromagnetic switches for energizing the sections of said conductor, an electrically operated safety signal for a section, which signal is connected in a circuit normally closed by the switch of said section in its open position with respect to the section, an electrically operated danger signal for said section, which signal is connected in a circuit energized by said section, and an electrically operated caution signal which is connected in a circuit energized by the next advance section.

32. In an electric railway system, the combination with a current feeder and a series of normally dead sectional conductors, of automatically operated switches for connecting said sectional conductors to the current feeder and for rendering the sectional conductor immediately in the rear of a preceding car temporarily inoperative by the following car, and branch circuits for controlling said switches, said branch circuits being normally without current potential.

33. In an electric railway system, the combination with a current feeder, a series of normally dead sectional conductors and a signal adjacent to each sectional conductor, of automatically operated switches for connecting said sectional conductors to the current feeder and for rendering the sectional conductor immediately in the rear of a preceding car temporarily inoperative by a following car, branch circuits for controlling said switches, said branch circuits being normally without current potential, and means whereby one of said signals is displayed to indicate the presence of a train in an advance section.

34. In an electric railway system, the combination with a current feeder and a series of normally dead sectional conductors, of automatically operated switches for connecting said sectional conductors to the current feeder and for rendering the sectional conductor immediately in the rear of a preceding car temporarily inoperative by the following car, and branch circuits for controlling said switches, said branch circuits being normally without current potential, together with additional means for enabling a car to pass over a section adjacent to a preceding section over which a car is then passing.

35. In a safety block electric railway system, the combination with the feeder, of a sectional conductor the sections of which are of considerable length with respect to the car or train, connections between the feeder and said sections, a normally closed electromagnetically-actuated switch and a normally-open electromagnetically-actuated switch included in each of said connections, the arrangement of the circuits being such that when the switch for a certain section is actuated to connect that section to the feeder a feeder connection of another section is opened.

36. A safety block electric railway system comprising

the combination with a feeder or main, of a sectional conductor the sections of which are of considerable length with respect to the car or train, connections between said sections and the feeder, and automatically operated switches included in said connections, each switch being so constructed and arranged that during the time it closes the feeder connection to its corresponding conductor section it opens the feeder connection to another section and thus renders impossible the closing of said feeder connection.

37. In a system for controlling the movements of electrically operated railway vehicles, the combination with the power circuit, of automatic means for stopping the vehicle, and a pair of track-circuits one controlling a signal and governed by the power circuit and the other controlling the automatic stopping means and controlled by said first track circuit.

38. In a system for controlling the movements of electrically operated railway vehicles, the combination with the power circuit, of automatic means for stopping the vehicle energized by current derived from the power circuit, and a pair of block-circuits for different blocks one block circuit being governed by the power circuit and controlling a signal and the other controlling the automatic stopping means and being controlled by the first block circuit.

39. In a system for controlling the movements of electrically operated railway vehicles, the combination with the power circuit, of automatic means for stopping the vehicle, and a pair of block circuits for different blocks, each forming a branch of the power circuit and one controlling a signal and the other controlling the automatic stopping means and being controlled by the first block circuit.

In witness whereof I have hereunto set my hand this 27th day of March, 1900.

WILLIAM B. POTTER.

Witnesses:
BENJAMIN B. HULL,
ALEX F. MACDONALD.