No. 714,746. Patented Dec. 2, 1902.

W. ROBINSON.

ELECTRIC RAILWAY SYSTEM.

(Application filed Jan. 15, 1898.)

(No Model.) 2 Sheets—Sheet 1.

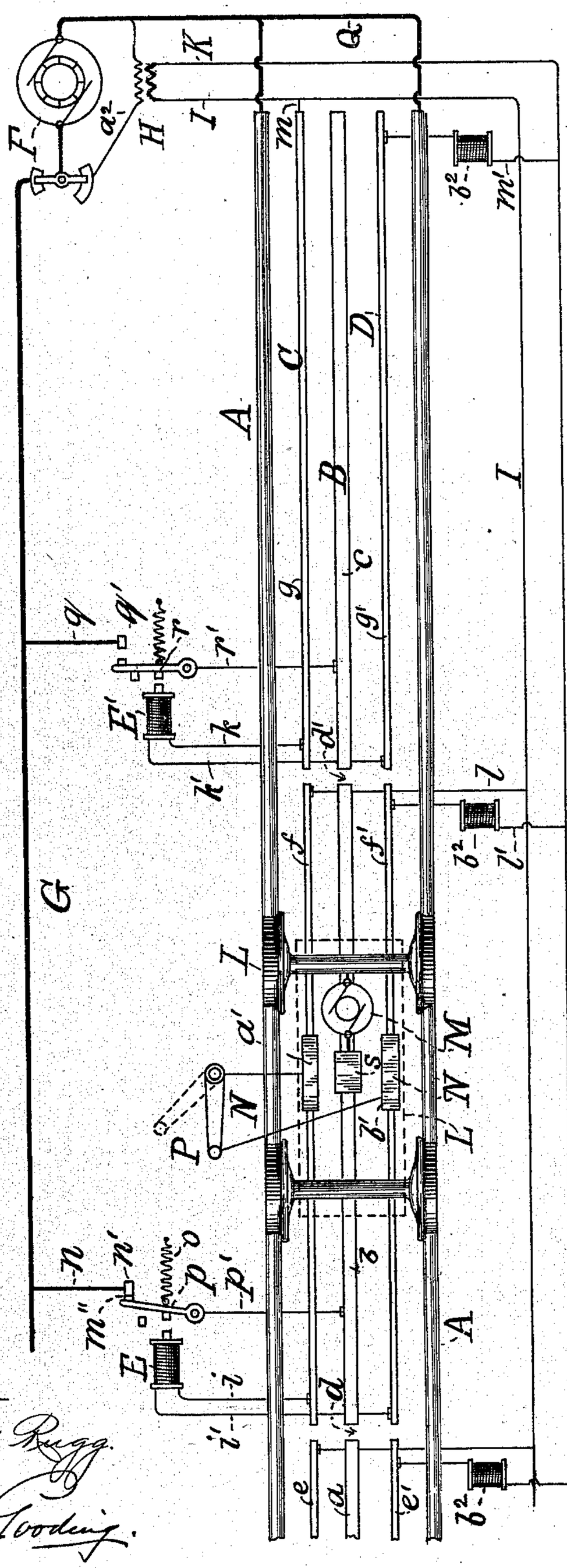

FIG. 1.

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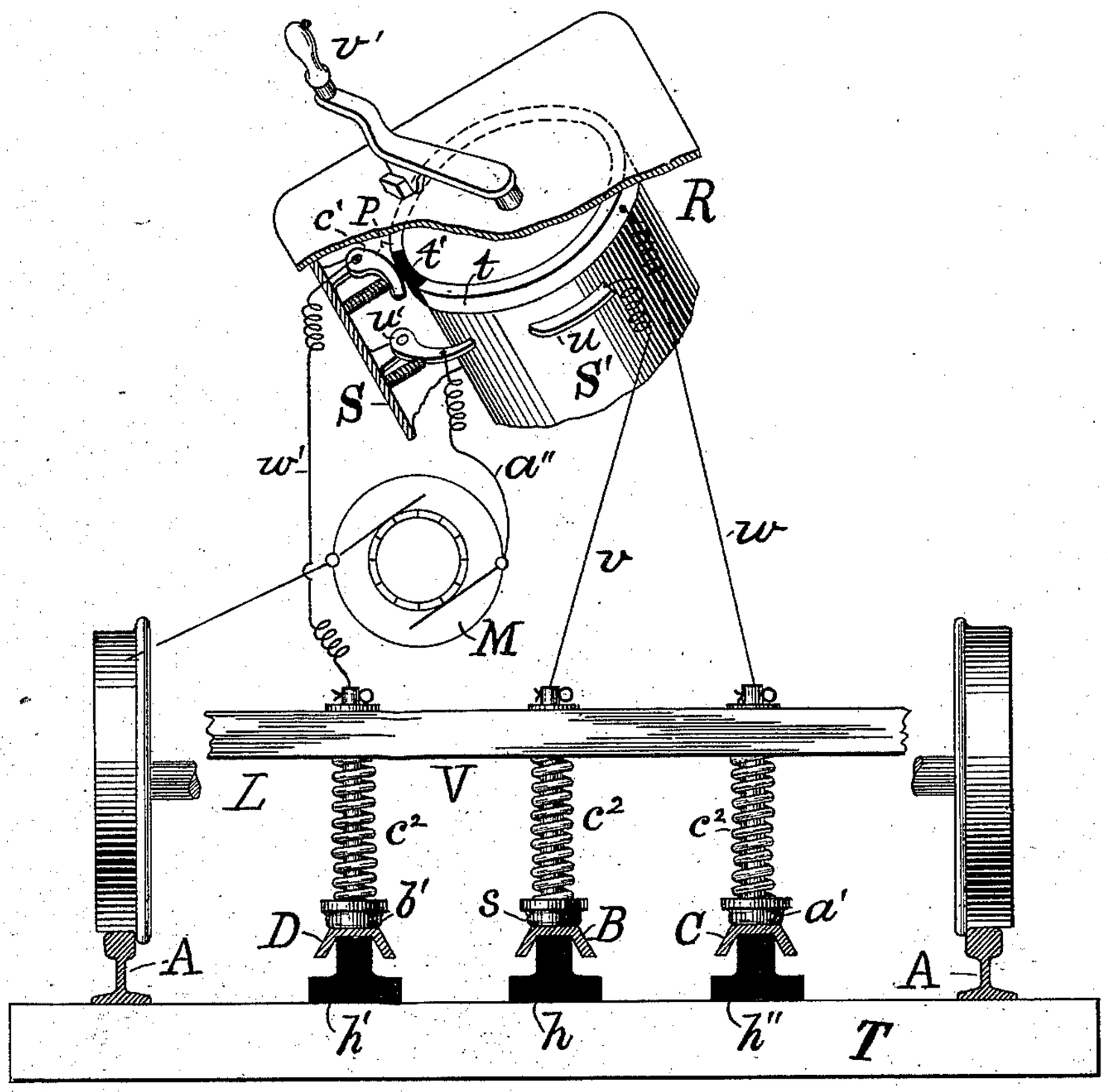

Fig. 2.

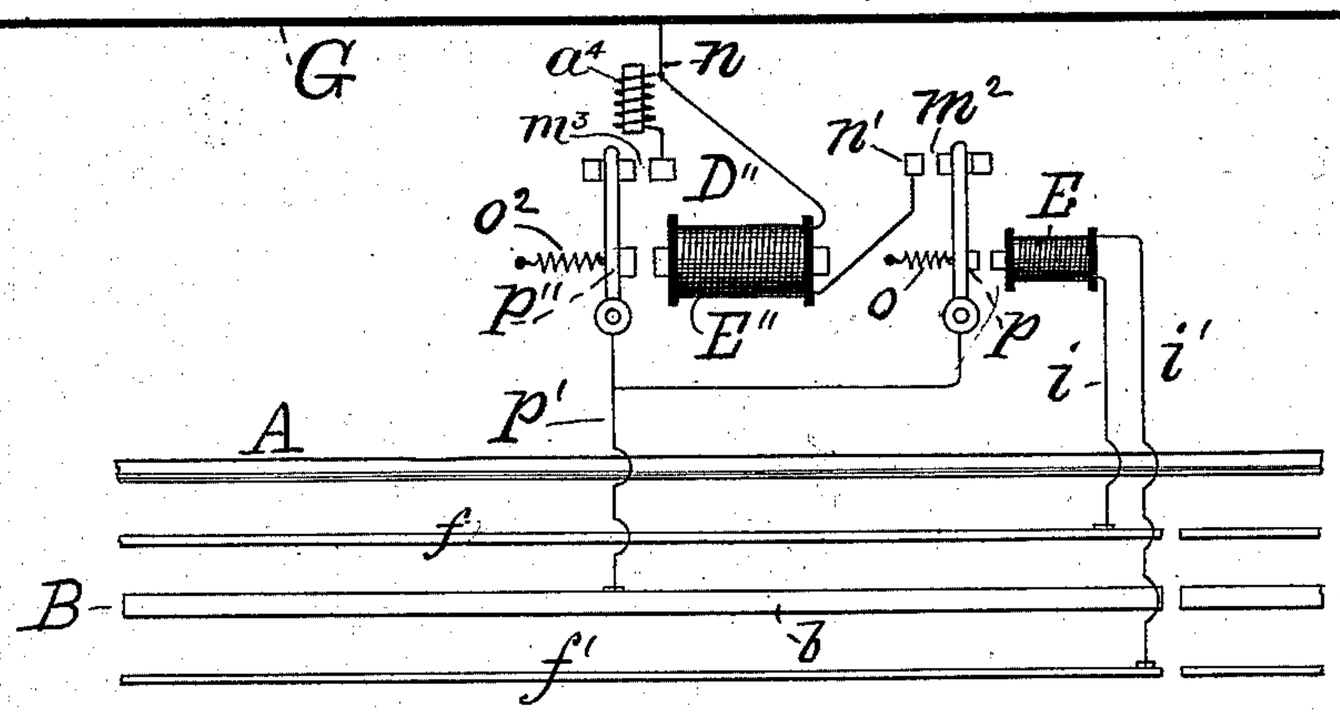

Fig. 3.

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UNITED STATES PATENT OFFICE.

WILLIAM ROBINSON, OF BOSTON, MASSACHUSETTS.

ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 714,746, dated December 2, 1902.

Application filed January 15, 1898. Serial No. 666,805. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ROBINSON, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented a new and Improved Electric-Railway System, of which the following is a specification.

The nature of my invention will be understood from the description which follows, reference being had to the accompanying drawings, which form a part of this specification.

Figure 1 is a diagrammatic representation of an electric railroad embodying the main features of my invention. Fig. 2 is a view, partly in cross-section, showing the connection of the electric circuits with the controller on the car; and Fig. 3 shows an alternative and preferable arrangement of magnets for the control of the working circuits.

A is a railroad-track of continuous construction.

B is the working conductor or "third rail," formed in successive sections *a b c* and supported by the track-ties T preferably midway between the service-rails A A, as shown, said sections being insulated from each other, as shown at *d d'*.

C D are additional independent contact-conductors divided into parallel sections *e e' f f' g g'*, insulated from each other and of the same length as the sections of the working conductor B. The conductors C D are also supported by the track-ties T preferably midway between the service-rails and the working conductor.

The conductors B C D may be supported by the track-ties in some cases without being insulated therefrom; but I prefer generally to insulate these conductors from the ties, as shown at *h h' h''*, Fig. 2.

The electromagnet E has its terminals connected to one end of the contact-sections *f f'* by the conductors *i i'*. In like manner the conductors *k k'* connect the terminals of the magnet E' to one end of the contact-sections *g g'*, as shown.

It will be understood that the magnets E E' are provided, respectively, with armatures arranged to be operated and controlled by said magnets in any usual or suitable manner.

F is an electric generator, and G a main-line conductor or feed-wire proceeding therefrom along the railroad-line and carrying a comparatively high-potential working current for operating the locomotive or car motors. The electrically-continuous railroad-track A A is the return-conductor for the working current.

H is a step-down transformer receiving primary current from the generator F and producing a secondary current of comparatively low potential. From this transformer the secondary conductors I K extend out along the line. The said conductors I K are electrically connected by the wires *l l'* to the contact-sections *f f'* at the ends of said sections opposite to those to which the magnet E is connected. In like manner said conductors I K are connected by the wires *m m'* to the contact-sections *g g'*. In each instance the conductors I K are connected, preferably, to the opposite ends of said contact-sections from those to which the respective magnets are connected.

It will be understood that the low-potential current from the transformer H, following the circuits described through the contact-sections *f f' g g'*, keeps the magnets E E' magnetized as their normal condition, the circuits of said magnets being in multiple with the line conductors I K.

The main feed-wire G is connected by the wire *n* to the anvil *n'*, (see Fig. 1,) and when the magnet E is demagnetized the spring *o* draws the armature-lever *p* against the anvil *n'*, thus connecting the main feed-wire G to the working section *b* of the working conductor B through the wire *n*, armature-lever *p*, and the wire *p'*. In like manner the demagnetization of the magnet E' connects the feed-wire G electrically to the section *c* of said working conductor through the wire *q*, anvil *q'*, armature-lever *r*, and wire *r'*.

As the magnets E E' are normally magnetized, and thus keep their armatures normally attracted, it is evident that the feed-wire G is normally disconnected from all the working sections *b c*, &c.

The contact-shoe or current-collector *s*, carried by the locomotive or car L and forming the terminal of the traveling motor M, travels in contact with the sectional working conductor B. The working circuit, passing

through the motor, continues through the wheels of the car to the service-rails of the track, which form the return-conductor.

The locomotive or car L is provided with the short-circuiting device N, which makes short-circuit connection between the parallel sections *f f' g g'*, &c., of the contact-conductors C D as the train progresses, thus demagnetizing the magnets E E' in succession by short-circuiting them, and thereby connecting the sections *b c*, &c., of the working conductor B in succession to the feed-wire G in the manner already described.

The short-circuiting device N is made in sections, consisting of the contact-shoes *a' b'*, electrically connected by the switch P, which when closed makes a perfect short circuit between the parallel contact-sections *f f'*, but when open destroys the short-circuiting connection between said sections. This switch P is connected with the controller R in such a way that when the train is using working current the switch P is automatically closed; but when the working current is cut off from the motors the said switch P is automatically opened, thus allowing the low-potential current to pass along the contact-sections *f f'* to the magnet E, magnetizing the same. This magnet, attracting its armature *p*, as is evident, opens the working circuit at *m''*, thus cutting off the feed-wire G from the working-conductor section *b* of the third rail B. This action will be clearly understood on reference to Fig. 2, in which the controller R is provided with the outer stationary case S and the inner revolving drum S' in any usual or suitable manner. The drum S' is provided with the insulated metal ring *t*, extending around the drum S', except that the ends of said ring are slightly separated by the insulation *t'*. The key or spring-clip *c'* is connected to the interior of the outer case S and presses against the ring *t* as the latter revolves, making perfect electrical connection between said ring and spring-clip. The working current passes from the working conductor B by the wire *v* to the drum S' of the controller R for distribution and use in the usual or any suitable way. The contact-conductor C is connected through the shoe *a'* and wire *w* to the ring *t*, and the contact-conductor D is connected in like manner to the spring-clip *c'* through the shoe *b'* and the wire *w'*. When the controller-handle *v'* is in its off or dead position, as shown in the drawings, the spring-clip *c'* rests on the insulation *t'*, thus destroying short-circuiting connection between the conductors C D.

The wire *v*, carrying working current, is electrically connected to the metallic plate or section *u* on the drum S', and the spring-clip *u'*, connected flexibly to the case S, is electrically connected by the wire *a''* to the motor M. The plate *u* and clip *u'* are to be regarded as the first of the working contacts to be electrically connected and the last to be disconnected in the working circuit when the current is turned "on" or "off" by the movement of the controller-drum S' in one direction or the other.

It will be noticed by inspection that the distance between the plate *u* and clip *u'* of the working circuit is greater than the distance between the end of the ring *t* and the clip *c'* of the short-circuiting device. Consequently when the controller-handle *v'* is turned to the right from the off position electric connection is made between the said ring *t* and clip *c'*, thus short-circuiting and demagnetizing the magnet E, for instance, before connection is made between the working plate *u* and the clip *u'*. Conversely when the handle *v'* is turned to the off position, as indicated in the drawings, the plate *u* and clip *u'* are separated before the ring *t* and clip *c'* are separated—that is, in turning the controller-drum into an operative position the circuit is closed through the short-circuiting device N and the magnet E thus demagnetized and the contact-points *m''* closed before the working circuit is closed between the plate *u* and clip *u'*. Again, in turning off the current from the motors the working circuit is opened between the plate *u* and clip *u'* before the circuit is opened between the ring *t* and the clip *c'*. Consequently the magnet E continues demagnetized until the working current has ceased to flow across the contact-points *m''*. When, therefore, the magnet E finally opens the contact-points at *m''*, there can be no flashing or burning at those points, since there is no current passing over them.

It will be understood from the foregoing that when the controller is in the off position and the contacts *t c'* disconnected the low-potential current passes to the magnet E, magnetizing the same and opening the working circuit at the points *m''*. Thus the working circuit is opened not only at the controller, but also at the points *m''*, even when the section is occupied by a train. It is evident then that by the simple means described not only is the working current cut off from all sections unoccupied by trains, but also when a train stops at a station or elsewhere or is coasting the working current is wholly cut off from all connection with the track and train. Thus there is no possible danger of shock on sections unoccupied by trains or at stations or elsewhere in the vicinity of standing or coasting trains, since the working sections under all these conditions are absolutely dead.

On reference to Fig. 1 it will be seen that the contact shoes or brushes *a' b'*, constituting elements in the short-circuiting device N, are longer than the contact-shoe *s* of the working circuit, said shoes *a' b'* extending at both ends beyond the ends of the shoe *s*. Thus the magnet E is kept under short circuit and demagnetized until after the shoe *s* has left the section *b* of the working conductor B. It is

evident then from this relative arrangement of contact-shoes that the working current has ceased to flow across the contact-points m'' before the magnet E withdraws the lever p from the anvil n'. Consequently there can be no burning or arcing when the contact-points at m'' are separated.

Referring to Fig. 3, the current used to operate the magnet E is necessarily comparatively light, especially when the contact-sections $f f'$ are laid on the track-ties without insulation. In order, therefore, to further guard against the possibility of the contact-points m'' sticking or burning owing to unforeseen or accidental conditions, I prefer to use the additional magnet E'', which is conveniently put in shunt-circuit between the feed-wire G and the working section b, as shown. In this case the demagnetization of the magnet E, releasing its armature p, closes the circuit of the magnet E'' at the contact-points m^2. The magnet E'' then instantly attracting its armature p'' closes circuit directly at the contact-points m^3 between the feed-wire G and the working section b.

By putting considerable resistance in the derived circuit D'' arcing at the points m^2 is reduced to a minimum even if these points be drawn apart while the current is passing over them. Furthermore, it is evident that most of the current passes over the points m^3 by short shunt-circuit to the working section b and that said points cannot be separated until the magnet E'' is demagnetized. Consequently if the contact-points m^2 be drawn apart while the current is passing there can still be very little arcing at said points m^2, since most of the current necessarily passes over the short shunt, including the points m^3.

Since the magnet E'' is a heavy one, it will attract strongly and draw a considerable distance, and the adjusting-spring o^2 consequently is made and adjusted to a high tension. The contact-points m^3, therefore, when open may be separated a considerable distance sufficient to insure the immediate extinguishment of any arc which might form between said points.

In order to further insure the prevention of possibly injurious arcing at the points m^3, I prefer to arrange an electric or magnetic "blow-out" a^4 to instantly extinguish or suppress the arc before its injurious development.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, substantially as described, of an electromagnet having its terminals connected to two stationary contact-conductors, a source of electric supply furnishing current to said magnet, a car provided with a circuit instrument or device arranged to make electrical connection between said stationary contact-conductors and a switch included in or forming a part of, said circuit instrument or device, said switch being arranged to disconnect and to establish electrical connection between the respective sections of said circuit instrument or device.

2. The combination, substantially as described, of an electromagnet included in a continuously-closed circuit and having its terminals connected to two stationary contact-conductors, a source of electric supply furnishing current to said magnet, a car provided with a short-circuiting device arranged to demagnetize said magnet by establishing short-circuiting connection between said stationary contact-conductors and a switch located on said car and included in or forming a part of, said short-circuiting device, said switch being arranged to open and to close electrical connection between the respective sections of said short-circuiting device.

3. The combination, substantially as described, of an electromagnet included in a continuously-closed circuit composed in part of two parallel lines of contact-conductors, a source of electric supply furnishing current to said magnet, said magnet controlling an additional circuit, a car provided with a short-circuiting device arranged to demagnetize said magnet by making short-circuiting connection between said parallel contact-conductors, and a switch located on said car and included in and forming a part of said short-circuiting device, said switch being arranged to open and close electrical connection between the respective sections of said short-circuiting device.

4. In an electric-railway system, the combination, substantially as described, of a plurality of electromagnets included in continuously-closed circuits formed in part of two parallel lines of sectional contact-conductors, a source of electric supply furnishing current to said respective magnets, a car provided with a short-circuiting device arranged to demagnetize said magnets in succession by making short-circuiting connection successively between the respective sets of parallel sections of contact-conductors to which said respective magnets are connected, and a switch located on said car and included in and forming a part of said short-circuiting device, said switch being arranged to open and close electrical connection between the respective sections of said short-circuiting device.

5. In an electric-railway system the combination, substantially as described, of a feed-wire, the working conductor formed in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, a source of electric supply, conductors proceeding therefrom, and a plurality of electromagnets receiving current simultaneously and directly from said conductors, each of said magnets being included in a continuously-closed circuit formed in part of parallel sections of contact-conductors, the actuation of each of said respective magnets operating to connect one of said sections of working con-

ductor to said feed-wire and to disconnect the same therefrom, a traveling short-circuiting device arranged to demagnetize said magnets in succession by making traveling short-circuiting connection between said parallel sections of contact-conductors, a switch included in and forming a part of said short-circuiting device, said switch being arranged to open and close electrical connection between the respective sections of said short-circuiting device.

6. In an electric-railway system, the combination, substantially as described, of an electromagnet having its terminals connected to two stationary contact-conductors, said magnet being arranged to control and determine the position of the working conductor relatively to its connection with or disconnection from the main working feed-wire, a source of electric supply furnishing current to said magnet, a motor-car provided with a circuit instrument or device arranged to operate said magnet by making electrical connection between said stationary contact-conductors, and a switch located on the car-controller and operated thereby, said switch being included in and forming a part of said circuit instrument or device and arranged to open and close electrical connection between the respective sections of said circuit instrument or device.

7. In an electric-railway system, the combination, substantially as described, of a stationary magnet with its circuit, a motor-car provided with a contact-making device making traveling contact with a portion of said magnet-circuit, and the car-controller provided with a switch connected to said contact-making device independently of the usual working circuit-switches, the movement of said controller in opposite directions operating to open and close said switch and thereby to control the magnetization and demagnetization of said stationary magnet, through said traveling contact-making device.

8. In a motor-car, the combination of a contact-making device formed in sections and arranged to make traveling electrical connection between two stationary conductors, and the car-controller provided with a switch connected to said contact-making device and forming a part of the same, the movement of said controller in opposite directions operating to open and close electrical connection between the contact-sections of said contact-making device, substantially as described.

9. In a car-controller, the independent switch consisting substantially of the incomplete ring t located on the revolving drum S′ and having its ends insulated from each other and the clip c' arranged to complete circuit by pressing against said ring t, in combination with the initial contact-plate u and clip u' of the working circuit, the distance between said plate u and clip u' of the working circuit being greater when the controller is in the "off" position than the distance between the said ring t and clip c' of the independent circuit when said controller is in the "off" position, whereby said independent circuit will be closed earlier and opened later than the working circuit through the motor.

10. In an electric-railway system, the combination, substantially as described, of a feed-wire, the working conductor made in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, an independent circuit under control of the motor-car and including a primary or relay magnet, a secondary magnet under control of said primary magnet said secondary magnet operating to directly connect said working conductor to said feed-wire and to disconnect the same therefrom.

11. In an electric-railway system, the combination, substantially as described, of a feed-wire, a working conductor made in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, a circuit continuously closed, a primary or relay magnet included therein, a secondary magnet of greater power under control of said primary magnet, said secondary magnet operating to directly connect said working conductor to said feed-wire and to disconnect the same therefrom, and a traveling short-circuiting device arranged to demagnetize said primary magnet.

12. In an electric-railway system, the combination, substantially as described, of a feed-wire, a working conductor made in successive sections normally disconnected from said feed-wire, a motor traveling in electrical connection with said working conductor, a circuit continuously closed, a primary or relay magnet included therein, means for demagnetizing said magnet by short-circuiting, a secondary magnet, of greater power than said primary, included in shunt-circuit around the contact-points making connection between said feed-wire and working conductor, the circuit of said secondary magnet being under control of said primary magnet, said secondary magnet operating to connect said feed-wire to said working conductor and to disconnect the same therefrom.

13. The combination, substantially as described, of an electromagnet having its terminals connected to two stationary contact-conductors, a source of electric supply furnishing current to said magnet, a car provided with a circuit instrument or device arranged to make electrical connection between said stationary contact-conductors, and means for making and breaking electrical connection between said contact-conductors, through said circuit instrument or device.

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Witnesses:
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F. E. SMITH.