(No Model.) 2 Sheets—Sheet 1.

F. C. ESMOND.

CLOSED CONDUIT RAILWAY SYSTEM.

No. 551,535. Patented Dec. 17, 1895.

FIG. 1.

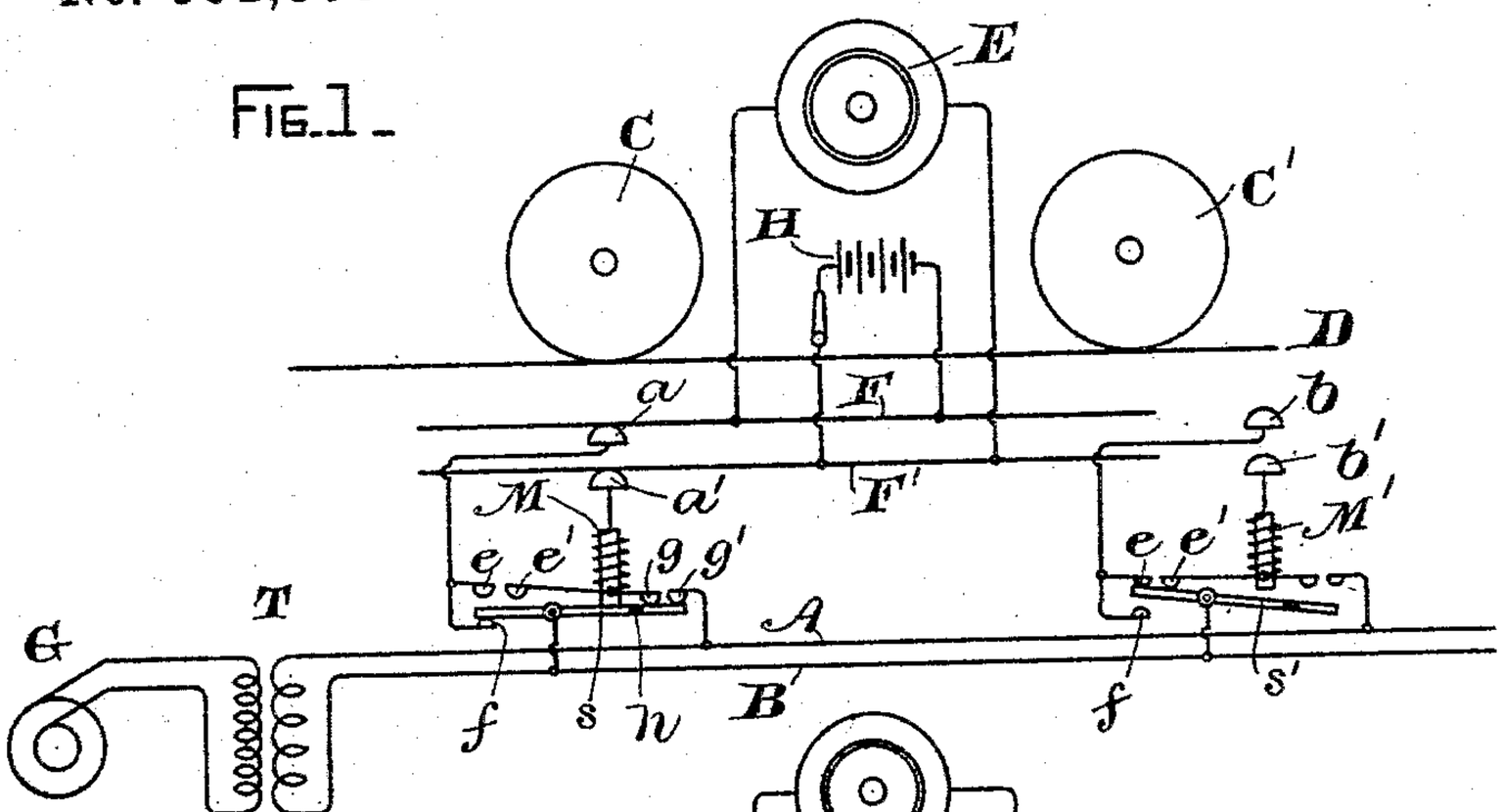


FIG. 2.

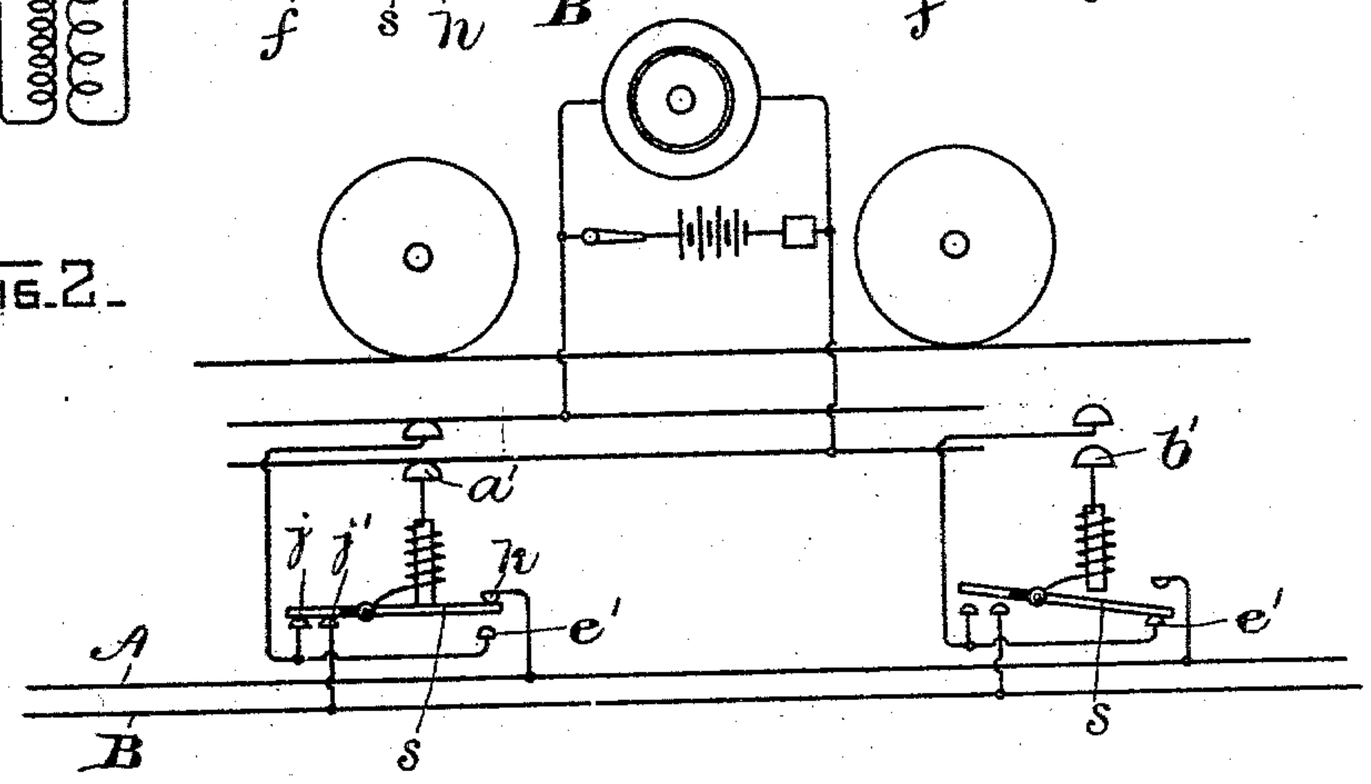
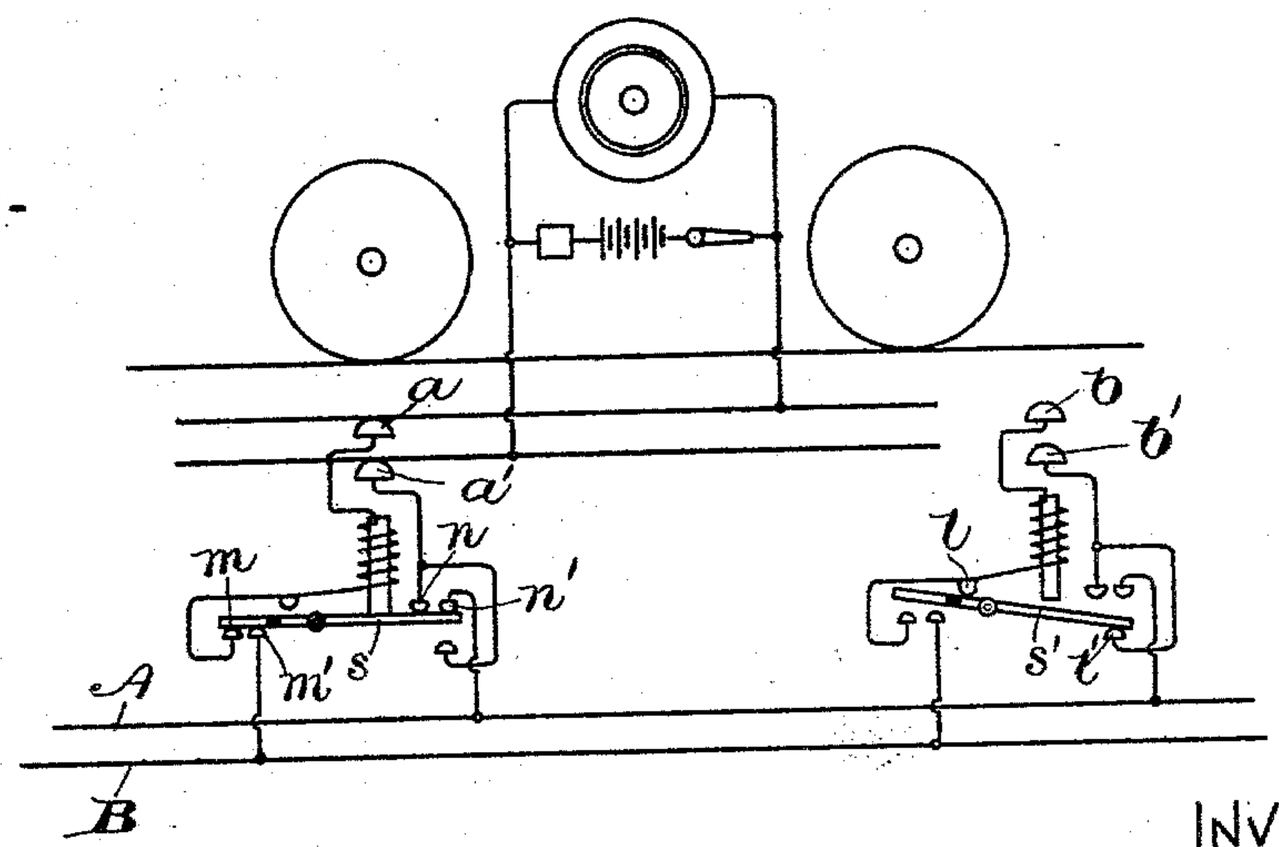


FIG. 3.



WITNESSES.

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(No Model.) 2 Sheets—Sheet 2.

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CLOSED CONDUIT RAILWAY SYSTEM.

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FIG 4.

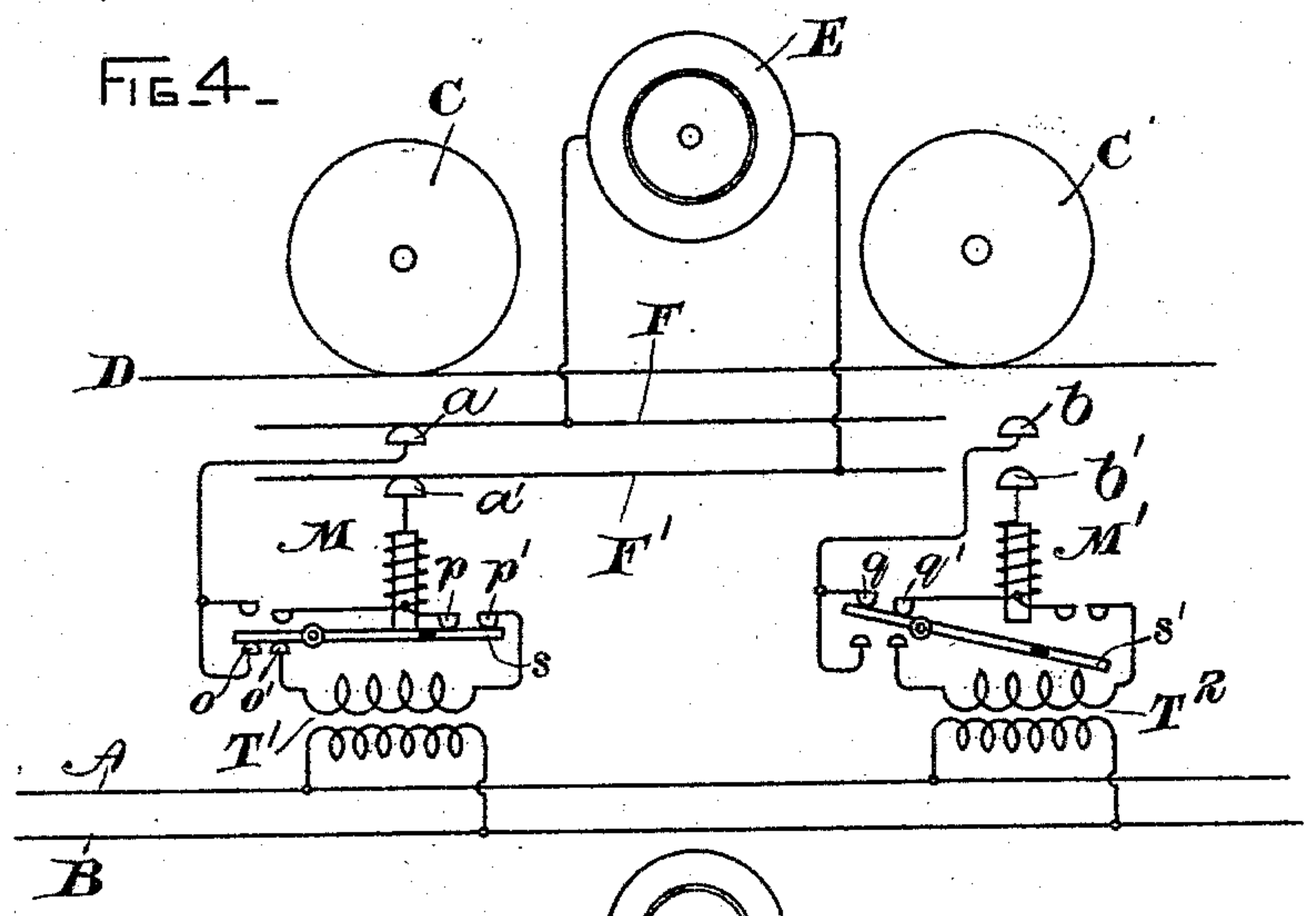


FIG 5.

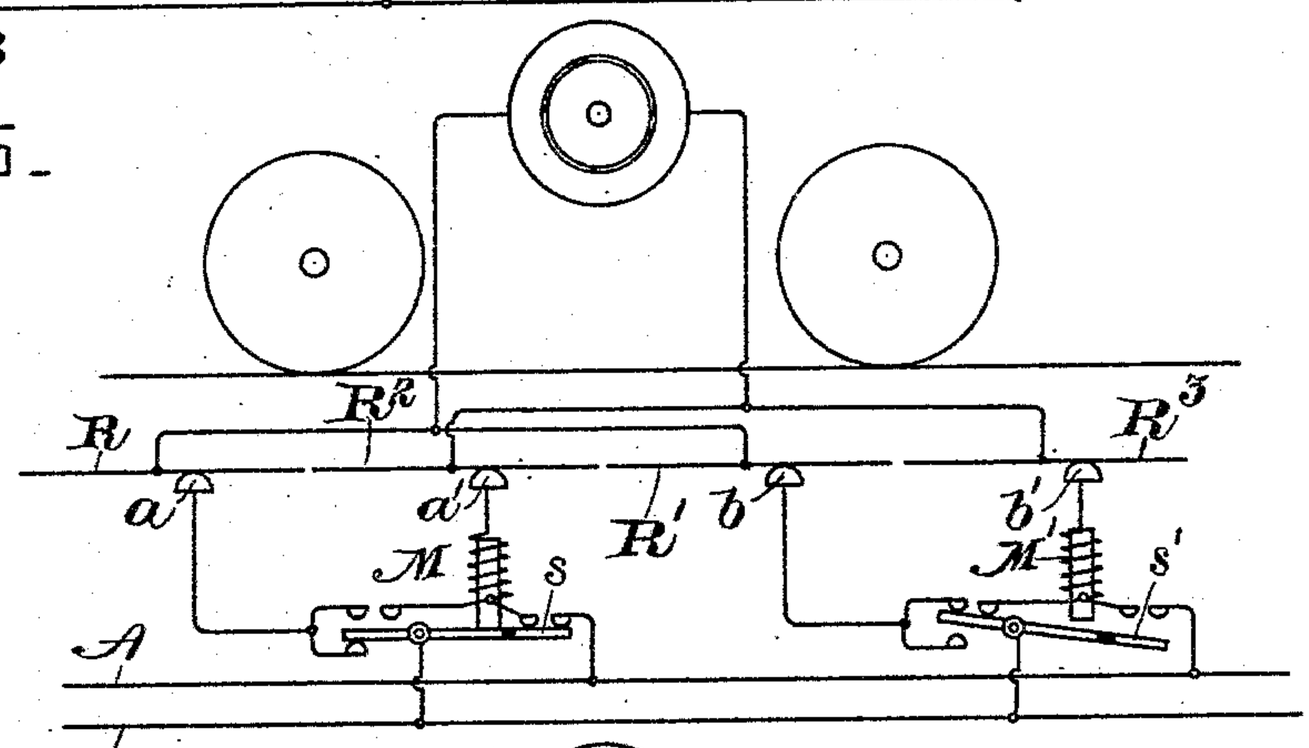
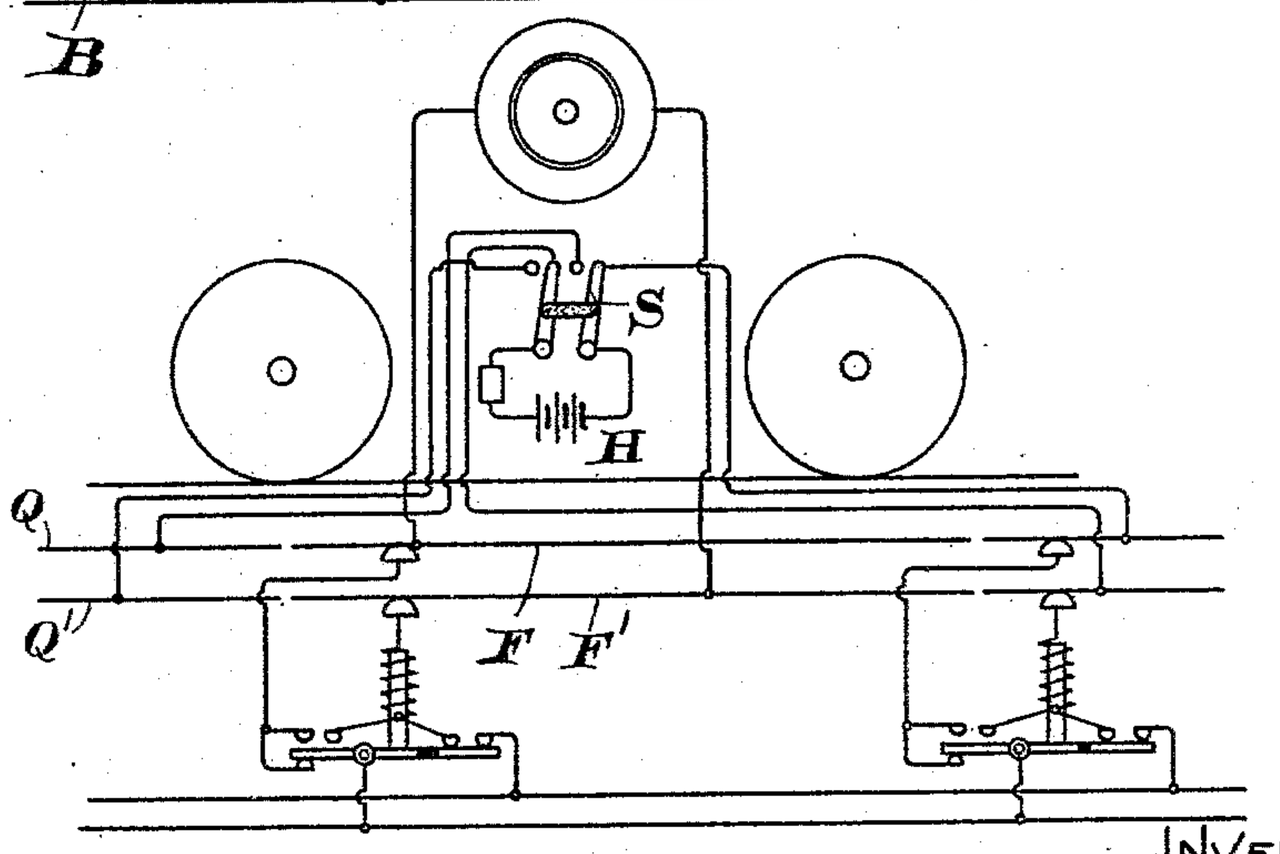


FIG 6.



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UNITED STATES PATENT OFFICE.

FREDERICK C. ESMOND, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE ESMOND ELECTRIC TRACTION COMPANY, OF WEST VIRGINIA.

CLOSED-CONDUIT-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 551,535, dated December 17, 1895.

Application filed April 12, 1895. Serial No. 545,440. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK C. ESMOND, a citizen of the United States, residing at Brooklyn, county of Kings, State of New York, have invented certain new and useful Improvements in Closed-Conduit-Railway Systems, of which the following is a specification.

The present invention comprises improvements in closed-conduit-railway systems of the general character in which there is, first, a line-circuit comprising positive and negative supply-conductors; second, working-conductor sections normally disconnected from the line-circuit, consisting of comparatively short rail sections or points insulated from one another, and electrically alive only when in the neighborhood of a car, and, third, a car or train driven by one or more electric motors, and provided with suitable collectors making contact with the working sections, and provided with some means for connecting the working sections successively with the main line-circuit.

In the various modifications herein described it will be observed that the working sections are connected and disconnected from the line-circuit by an electromagnetically-operated switch, so arranged that when the line is off the magnet-terminals are connected to pairs of working sections, but when the magnets are energized and the switches thrown the working sections, constituting a pair, are no longer connected through the magnet, but are joined respectively to opposite sides of the line-circuit, while the magnet is included in the line-circuit for holding the switching mechanism in the desired position until the car passes. Such an arrangement of switching mechanism constitutes an important feature of the invention. A variety of ways may be used for energizing the magnets when so coupled. For example, in Figure 1 current taken to the working sections from one switch is fed by the collectors to the motors, and by a shunt to the magnet of an advance set of sections, while in Fig. 6 the magnets are successively energized, so as to pick up the switches by current from a storage-battery or other source on the car. So, too, the pairs of working sections may be arranged in various ways. In some of the figures the sections making up a pair are at right angles to the track, while in Fig. 5 the sections are all arranged longitudinally one after the other in the direction of travel, each two succeeding sections constituting a pair normally coupled by the magnet-circuit, as already explained. Many other modifications also are to be included in the invention.

The arrangement herein described is especially adapted to all-metallic supply-circuits, thus making the system peculiarly applicable for alternating currents, though it may be used in direct-current systems as well.

Figs. 1, 2, 3, 4, 5, and 6 illustrate in diagram a number of modifications of the invention.

Referring first to Fig. 1, G represents the supplying generator which in this case is assumed to be an alternating single-phase machine feeding the mains A B through a transformer T. The secondary mains will supply the railway for a distance not too great for economical transmission of power, the secondaries being multiplied and fed from high-tension mains through transformers as may be necessary to supply the entire railway system. C C′ represent the wheels of a car or locomotive traveling on rails D in the ordinary manner. The driving-motors, of which there may be one or more, are shown conventionally at E. Its terminals are connected respectively with collector-bars F F′, attached to and moving with the car and long enough to somewhat more than span the distance from one set of working sections to the next. *a a′* and *b b′* are pairs of working sections, here shown as short contact spots, though, as is well known in the art, longer rail-sections may be substituted. Ordinarily the mains A B will be located underground or carried upon poles, while the working sections will be exposed on the street-surface. For each pair of working sections there is provided a switch *s s′*, which normally stands under the influence of gravity or a spring in a position shown at *s′* with the line-circuit to the working sections open. When the switch is thrown to the closed position shown at *s* the magnet-circuit joining the contact-points is opened at the contacts *e e′*, and the contact-points are respectively connected to the supply-mains A B by the

contact f and the contacts $g\ g'$. Current then flows from the mains through the contact f, (assuming that B is the positive main,) contact-point a, and collector-bar F, and returns to the negative main through collector F', contact-point a', the magnet M and contact-points $g\ g'$, throwing the magnet into the line-circuit, and holding the switch closed until the collectors leave the corresponding contact-points. The switch s is divided by insulation at the point h, so as to avoid short-circuiting the line when in the closed position, and so is the equivalent of, and may be regarded as, a pair or set of switches operated simultaneously by the pick-up magnet. When the collector-bars touch the contact-points $b\ b'$ a circuit shunting the motor is formed from the collector F through contact-points $e\ e'$ and magnet M' to the collector F', which, of course, will throw the switch s' and change the circuit connections, as already explained. For picking up the switches after the motor-circuit has been broken, or when for any reason they are not thrown by the line-current, a battery H or other source of current is carried on the car, which will have its terminals connected to the two collector-bars, and will, of course, complete the circuit through any one of the magnets where the car happens to be when the switch is in the open position.

In Fig. 2 a system is shown very similar to that already described, except in so far as the details of the switch mechanism are modified. One terminal of the magnet-circuit is connected as before to one of the contact-points of each pair, as shown at a' and b', and the other terminal is permanently connected to the pick-up switch. When the line-circuit is open the switch rests on a back contact e', so that there is electrical connection between the contact-points of each pair through the magnets, as in Fig. 1. When the line is closed this circuit is broken, the main B is connected to one of the contact-points through contacts $j\ j'$, and the main A is connected to the other contact-point through contact k. In this modification both sides of the supply-circuit are normally disconnected from the contact-points, while in Fig. 1 there is a normal connection between one of the mains and one of the contact-points when the pick-up switches are in their retracted position. Both arrangements are essentially the same and are to be included within the invention. The other parts of the modification shown in this figure correspond to the similar parts in Fig. 1, and the mode of operation will be readily understood.

In Fig. 3 there is a further modification, in which, as in Fig. 2, both sides of the line-circuit are broken at the pick-up switches. The switch s' is shown in the open position and the magnet-circuit between the points $b\ b'$ is closed through the contact l, the right-hand portion of the switch s', and contact l'. When the line is closed the switch is thrown to the position indicated at s, joining contact-point a to the main B through contacts $m\ m'$, and joining contact a' to the main A through contacts $n\ n'$. The magnet-circuit directly connecting the contact-points is broken as before, and the magnet included in the main motor-circuit.

In Fig. 4 transformers T' T^2 are provided for each pair of contact-sections. The motor-circuit on the secondary of the transformers is closed, as shown at the switch s, through contacts $o\ o'$ and $p\ p'$. When the switch is in the position seen at s' the secondary transformer-circuit is opened at two points and the magnet-circuit completed between the contact-points by contacts $q\ q'$.

In all of the modifications thus far described, the contacts of each pair are arranged opposite one another in two rows. In the arrangement shown in Fig. 5, an electrically similar system is shown, in which the contact-sections are all arranged one after the other in the direction of travel. In this case $a\ a'$ constitute one pair and $b\ b'$ a second pair. With the exception of this difference in the arrangement of the contact-sections, the switching mechanism is exactly the same as in Fig. 1. To make contact with the working sections, overlapping sets of collectors are provided on the car, of which R R' constitute one set and are connected to one terminal of the motor, while R^2 R^3 comprise a second set and are connected to the second motor-terminal. The switch s is shown closed and the switch s' in the open position to illustrate the division of the current through the magnet of an advance pair of sections. Starting from the main B, the circuit can be traced through contact-point a to the motor, and back through contact-point a' to the main A. A shunt-circuit around the motor is formed through contact-point b, magnet M', and contact-point b', and will, of course, throw the pick-up switches successively as the corresponding contact-points are bridged by the collectors.

The modification shown in Fig. 6 differs from any of those already described only in the means for throwing line-switches. As thus far explained, it has been accomplished by shunting a portion of the line-current around the motor. In Fig. 6, in addition to the regular collector-bars F F', which are joined to the motor, accessory collector-bars Q Q' are provided at each end of the car, which will in practice be comparatively short and bridge the contact-sections of each pair before they are reached by the main collector. A battery H or other source of current is provided on the car, and has a switch S by which its terminals may be connected with either pair of the accessory collectors, according to the direction of travel of the car. If the car be moving to the right, as indicated by the arrow, the battery-circuit will be completed through the magnet joining the advance pair

of sections by the collectors Q Q′, so that the switch will be thrown and will be held up by the line-current when the contact-points reach the main collectors F F′. One set of accessory collectors will be used in one direction and the second in the return direction of travel, as will be readily understood.

The arrangement herein described may be used both with a direct and alternating distribution system, and with obvious modifications may be adapted to alternating systems of any desired number of phases. One of its principal advantages is that it affords a simple and reliable arrangement of switching mechanism for connecting the contact-sections with both sides of the line-motor circuit, so that an all-metallic circuit may be used when desired without multiplying the switches or the number of working-conductor sections, which are exposed in the street.

In using the word "sections" in the claims hereinafter made I do not mean to be limited to the length of the sections employed. They may be short, as is indicated in the drawings, and sometimes called "contact-points." This is the preferred arrangement, though in other cases the sections may be of such greater length as will be desirable in any given case.

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

1. The combination of line conductors with working contact sections normally connected in pairs through a magnet circuit when the sections are disconnected from line, and a switch or set of switches actuated by the magnet on the presence of a car for breaking the first named magnet circuit, and connecting the corresponding contact sections respectively to opposite sides of the line circuit, as set forth.

2. The combination of line conductors with working conductor sections arranged in pairs, collectors on the car connected to opposite terminals of the motor or motors, a magnet connected when de-energized in a circuit bridging the working sections of each pair, and a switch or set of switches actuated by the magnet for breaking the first named magnet circuit, connecting the conductor sections with opposite sides of the line circuit, and including the magnet in the line circuit as set forth.

3. The combination of line conductors and working conductor sections with a switch or set of switches normally disconnecting the line conductors from the contact sections, but connecting the sections constituting each pair through a magnet, collectors traveling with the car, and means for forming a circuit through the magnet by the collectors, and thereby throwing the magnet into line circuit, as set forth.

4. The combination of an all-metallic supply circuit, pairs of contact sections, sets of collectors connected respectively to opposite terminals of the motor or motors, a switch for each pair of contact sections, a magnet for each switch in a circuit joining the sections of each pair when the line circuit is open, and adapted to throw the switch when energized, so as to break the magnet circuit between the contacts and couple the latter respectively to the line conductors, and means for holding the switch in the position closing the line circuit while the motor current is being collected from any given section or sections as set forth.

5. The combination of supply conductors, sectional working conductors between each branch of the motor circuit and the corresponding supply conductor, the sections being normally insulated from the corresponding supply conductors, switches for coupling the working sections to the respective supply conductors, and collectors on the car connected to opposite terminals of the motor, and bridging from one set of positive and negative sections to a similar set of sections, for establishing the circuit shunting the motor for throwing an advance set of working sections into circuit with the respective supply conductors.

6. The combination of supply conductors, pairs of contact sections, forming sectional positive and negative working conductors, a series of switches for connecting the sections with the corresponding supply conductors, a magnet for operating each switch, whose terminals are joined to the contact sections making up a pair in the open position of the line switches, and collectors joined to opposite terminals of the motors, as set forth.

7. The combination of an all-metallic supply circuit, pairs of contact sections, a magnet for each pair of sections normally in circuit between them, a switch or set of switches through which the circuit of the magnets is closed, as described, when the line is open, and adapted when thrown, to connect the respective contacts to opposite sides of the line circuit, and means for establishing the circuit through each magnet when the car is over the corresponding contact sections, as set forth.

8. In an alternating current railway system, the combination of an alternating source of supply, distributing mains and transformers with working conductor sections arranged in pairs, and forming the positive and negative working conductor, a switch or set of switches for each pair of contact sections normally connecting the sections through a magnet, and means for operating the switches on the presence of the car, so as to connect the working sections respectively with opposite branches of the secondary circuit of the transformer or transformers, as set forth.

In witness whereof I have hereunto set my hand this 8th day of April, 1895.

FREDERICK C. ESMOND.

Witnesses:

B. B. HULL,

A. F. MACDONALD.