(No Model.)

F. C. ESMOND.

CLOSED CONDUIT ELECTRIC RAILWAY SYSTEM.

No. 551,536. Patented Dec. 17, 1895.

FIG. 1.

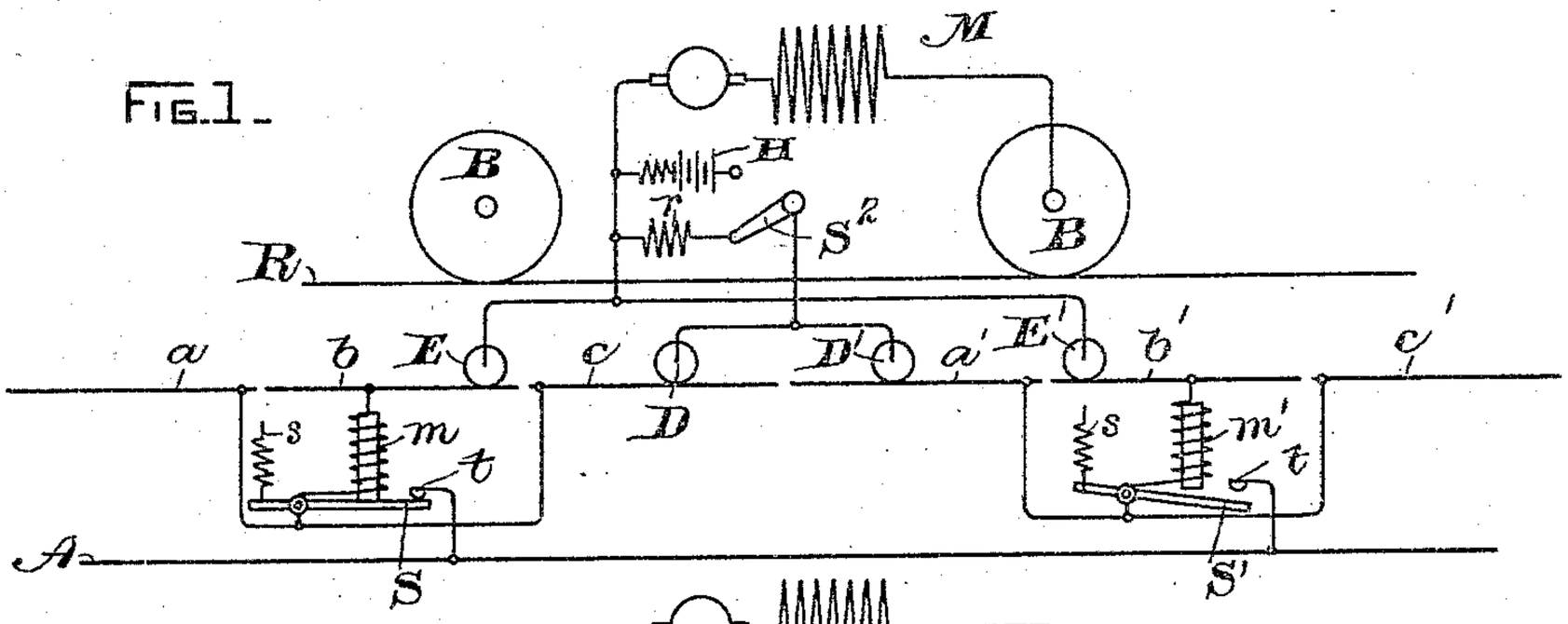

FIG. 2.

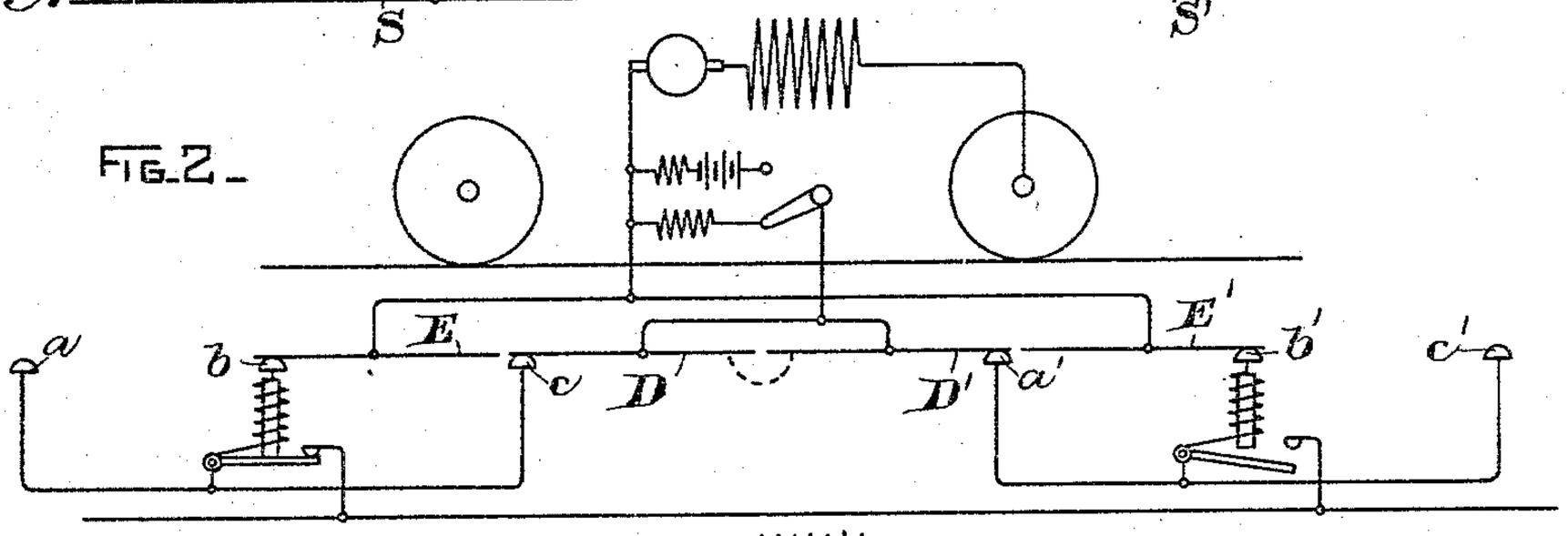

FIG. 3.

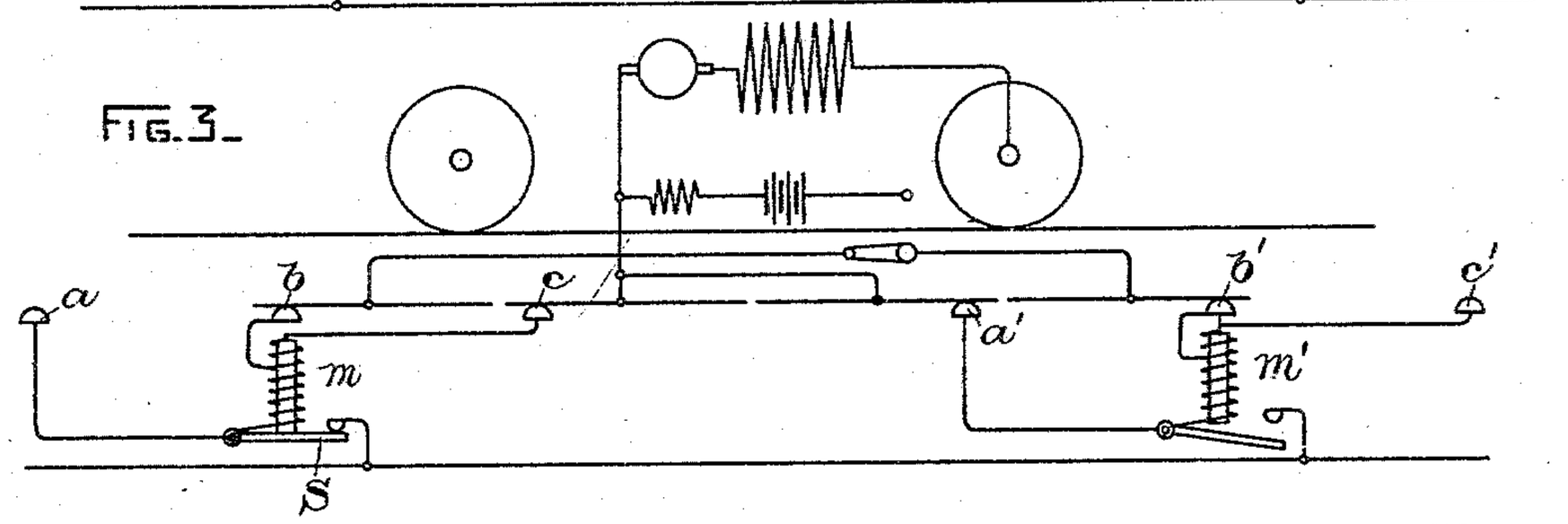

FIG. 4.

WITNESSES:

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UNITED STATES PATENT OFFICE.

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CLOSED-CONDUIT ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 551,536, dated December 17, 1895.

Application filed April 26, 1895. Serial No. 547,230. (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 Electric-Railway Systems, of which the following is a specification.

My present invention relates to an electric-railway system in which there are exposed working conductor sections or points which are normally disconnected from the supply conductor or feeders, but are brought into electrical connection therewith by electro-magnetically-operated switches whenever a car happens to be over or near a given section or sections. Railways of this general description are well known in the art, but have not heretofore been adopted in practical commercial use. The chief difficulty has been in securing reliable means of making the necessary temporary connection between the working sections and the supply-conductor, so that on the one hand there will be no break in the motor-circuit through failure of the switches to work, and on the other hand no failure to disconnect the sections, so as to leave them electrically dead after the car has passed.

The present invention provides certain novel features which I have designed in the belief that the system will operate satisfactorily in actual service. The system will be explained and the invention defined hereinafter. I may say, however, briefly, that the working conductor-sections are divided into sets of three, preferably arranged one after the other in the direction of the line of travel. A switch is provided for each set of sections and an electromagnet for connecting the sections with the supply-conductor and maintaining the connection during the proper interval, while a special arrangement of collectors on the car forms a branch circuit through the magnet of an advance set of sections, so as to close the switches successively and insure the intended operation of the system.

In the accompanying drawings, Figure 1 illustrates a railway system in diagram. Figs. 2 and 3 similarly illustrate somewhat modified forms of the invention, and Fig. 4 illustrates diagrammatically the way in which the switch-boxes are arranged with reference to the track.

Referring first to Fig. 1, A is a supply-conductor or feeder on which the desired potential is maintained by the generators at the station. The supply-conductor may be insulated and located in any desired manner and at any convenient distance from the track. Working conductor-sections are provided which ordinarily, in a street-railway, will be exposed on the surface of the street, though they may be arranged in a number of different ways known in the art. The sections are arranged in sets of three. The sections of one such set are marked in the drawings *a b c*, while the sections of an adjacent set are marked *a' b' c'*. Current passes from the working sections to the motor M and returns, as illustrated, through the car-wheels B and rails R. The return-circuit is therefore like that of the ordinary single-trolley system; but this is not essential to the invention, and may be formed in a variety of other ways. Switches S S' are provided, one for each section, and adapted to connect the working sections with the supply-conductor when closed and to disconnect them when open, as will be understood. The switches normally stand under the influence of gravity, or a spring *s*, in the position shown at S' with the working sections disconnected from the supply-conductor. When the switch is closed, circuit to the working sections is established through a contact *t*. For each set of sections there is an electromagnet *m m'*, having a winding connected at one end to the central conductor-section of each set, as at *b b'* and at the other terminal joined to the remaining sections of the set, as, for example, *a c*. A special arrangement of collectors is used on the car for connecting the working sections with the motor, which, as will be hereinafter explained, forms the necessary circuit through the magnet of an advance set of working sections, so as to close the line-switches at the proper time. In reality the parts used for this purpose constitute a single collector connected to one pole of the motor, but for convenience in definition and in explaining the invention I de-

scribe them as double collectors, of which one comprises the rollers or sliders D D′, so spaced that when the parts are in the position seen in Fig. 1 they bridge the adjacent end sections *c a′* of two adjacent sets of working sections. The other collector, or other part of the double collector E E′, bridges under the same conditions the central sections *b b′* of the like sets of sections. The parts are shown in Fig. 1 in the position which they occupy just after the circuit is completed through the magnet *m′* of an advance set of sections, though the corresponding switch S′ is shown open in order that it may be better contrasted with the showing at S. In this position the current is fed from the supply-conductor through the switch S, and then divides through multiple paths of substantially equal resistance leading to the motor. One path may be traced through the magnet *m*, section *b* and collector E. The other path passes through the remaining three working sections on which rest the rollers D D′ E′ in series, including also the magnet *m′* between the working sections *a′ b′*. The result will be to close the switch S′. The collectors D D′ are shown connected to the motor through a switch S^2 and a resistance of comparatively small amount *r*, preferably about equal to the resistance of one of the magnets. As soon as the switch S′ is closed, the line-current will be fed to the motor through it, and in passing through the magnet *m′* the switch will be maintained closed until the collectors leave the section *b′*. Before this happens, however, as will be understood, still another switch will have been thrown in the manner already explained.

For closing the line-switches at any time, as, for example, when the main circuit has been broken so as to de-energize the magnets, a storage-battery H or other source of electromotive force is usually carried on the car. The switch S^2 is arranged to close the circuit of the battery through the collectors D D′ joined to one terminal and the collectors E E′ to the other terminal. The battery may be charged when necessary by the line-current.

The modification in Fig. 2 demands only brief explanation, since it corresponds in all respects with Fig. 1, except that the working conductors *a b c*, &c., are shown as short contact-points which will be mounted on switch-boxes along the line of travel, set the necessary interval apart. The arrangement of the pick-up magnets and switches is the same as before. The collectors are formed of sections of some considerable length as compared with those in Fig. 1, and as indicated in dotted lines D D′ may form a single section.

In the modification shown in Fig. 3 there is present the same arrangement of working sections divided into sets *a b c*, *a′ b′ c′*, and collector-bars, as shown in Fig. 2. In this case, however, one terminal of the magnets is connected to the end section of each set, as at *c*, while the section *b* is connected to an intermediate point in the coil. With the parts as shown, with the switch S closed, the main circuit divides as before, one path including a portion of coil *m*, contact-point *b*, contact-point *b′*, a part of coil *m′*, contact-point *a′*, and to the motor. The other path includes the whole of magnet *m*, contact-point *c*, and to the motor. In this case the resistance of the magnets is divided substantially equally between the two paths, as in Fig. 1, though in a somewhat different manner. This change is the only material difference from the modification of Fig. 1, and the operation will be readily understood.

In Fig. 4 the rails R of a double-track road are shown. The supply-conductor A is arranged between the tracks and at the proper intervals are switch-boxes P, each of which will contain one switch and magnet for a single-track road, or two switches and magnets for a double-track road. To the switch-box lead connections *o o′* o^2, which connect the working-conductor sections or points, as more fully described in explaining Fig. 1.

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

1. The combination in an electric railway of a supply conductor, working-conductor sections or points arranged in sets of three, switches and magnets for operating the switches with double collectors so arranged and spaced with reference to the conductor sections that one spans the adjacent end sections of adjoining sets of conductors, while the second spans the central sections of the said sets for establishing a circuit through the magnet of an advance set of sections, as set forth.

2. The combination in an electric railway of a supply conductor, working conductor sections or points arranged in sets of three, a switch adapted to connect all three sections making up each such set to the supply conductor when closed, and an electro-magnet for each switch having an energizing coil connected between at least two of such sections when the switch is in the open position, as set forth.

3. The combination in an electric railway of a supply conductor, a series of working sections or points arranged longitudinally one after the other in the direction of the line of travel, and divided into sets, each of which comprises three successive sections, switches adapted to connect the different sets of working conductors to the supply conductor, magnets for actuating the switches having a coil connected between two at least of the sections of each set when the switches are open, and collectors on the car arranged to form a circuit from a live section of one such set through the magnet of an advance set of sections for closing the corresponding advance switch, as set forth.

4. The combination in an electric railway

of a supply conductor, working conductor sections arranged in sets of three, a magnet and switch for each such set, and collectors on the car forming multiple paths to the motor at the time when an advanced switch is to be closed, one path including the magnet operating the switch of a rear set of sections, and the other the magnet of an advance set of sections for closing the corresponding switch, as set forth.

5. The combination in an electric railway of a supply conductor, working conductor sections or points arranged in sets of three, magnets and switches for connecting the sets of working conductor sections with the supply conductor, and collectors on the car resting on four sections and forming multiple circuits from the supply conductor at the time when the magnet of an advance set of sections is energized, one such circuit leading direct from one section to the motor, and the other circuit including the remaining three sections in series, as set forth.

6. The combination in an electric railway of a supply conductor, working conductor sections or points arranged in sets of three, switches for connecting the said sets of sections with the supply conductor, and electro-magnets for operating the switches, the central section of each set being normally connected to the end sections of the said set through coils on the corresponding magnet, as set forth.

7. The combination in an electric railway of an insulated supply conductor, working conductor sections or points arranged in sets of three, a switch box for each set of sections, located outside the track, connections leading from the three sections of a set to a switch box, and a switch for connecting the sections with the supply conductor, as set forth.

8. The combination in an electric railway of a supply conductor, working conductor sections or points arranged in sets of three, double collectors arranged as described, and a battery or other source of current adapted to be connected to the different collectors, as set forth.

In witness whereof I have hereunto set my hand this 20th day of April, 1895.

FREDERICK C. ESMOND.

Witnesses:
B. B. HULL,
A. F. MACDONALD.