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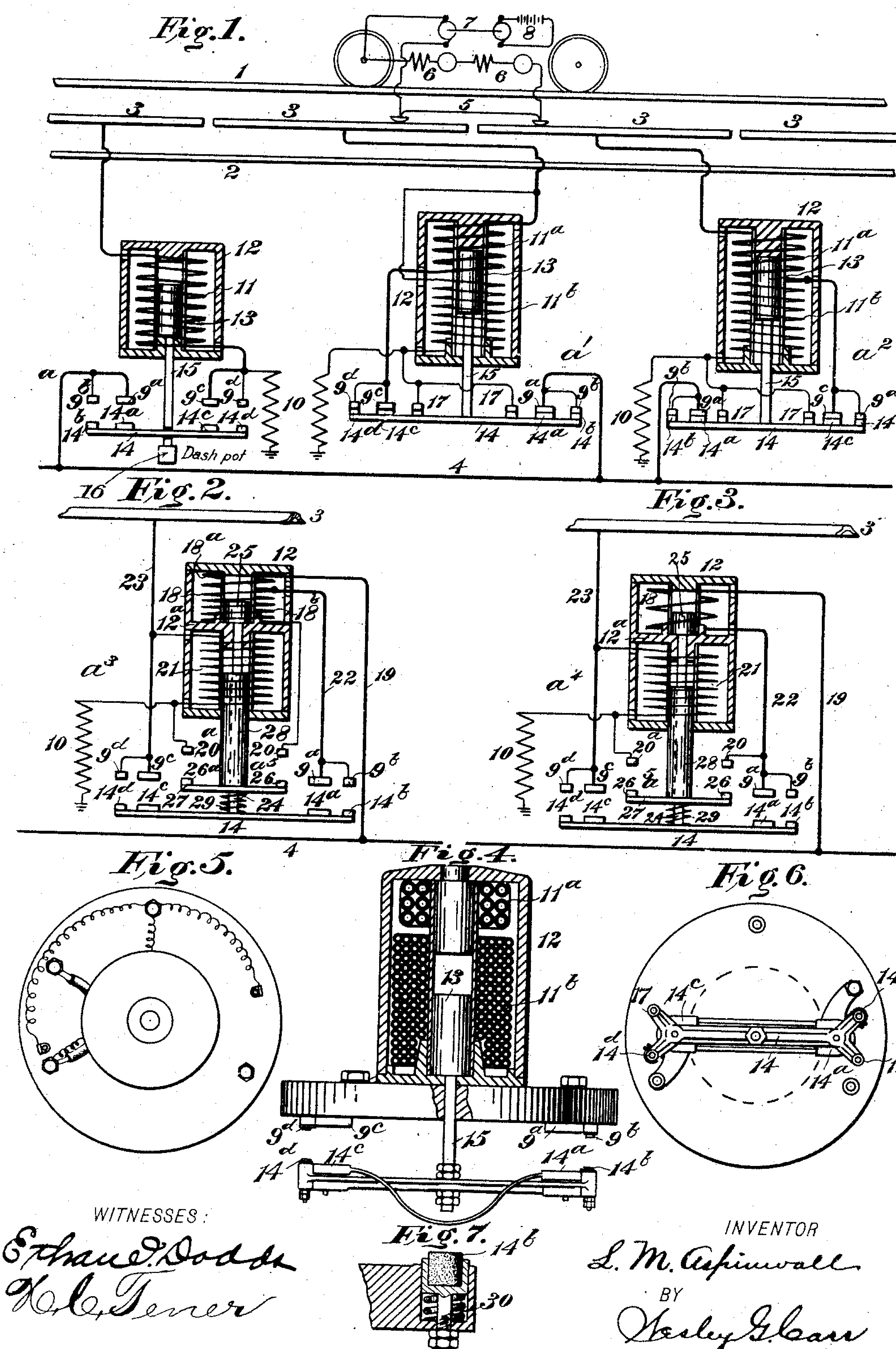
L. M. ASPINWALL.

ELECTRIC RAILWAY.

(Application filed Feb. 25, 1898.)

(No Model.)



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ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 620,404, dated February 28, 1899.

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To all whom it may concern:

Be it known that I, LOUIS M. ASPINWALL, a citizen of the United States, residing in Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electric Railways, (Case No. 772,) of which the following is a specification.

My invention relates to electric railways of the class embodying insulated feeders, exposed but normally dead roadway-contacts, and electromagnetic switches for automatically making and breaking the circuit from the feeder to the vehicle-propelling motor or motors.

The object of my invention is to provide a system which shall embody a single line of roadway-contacts and switches for successively cutting the same into and out of circuit, which shall be simple and inexpensive in construction and flexible and certain in operation both as regards the closing of the main circuit when the traveling contact-shoe comes into engagement with the proper roadway-contact and the opening of the same when the shoe has left such contact.

It has been proposed prior to my invention to employ a single line of roadway-contacts for performing the two functions of initially actuating the switches to close the main circuit and for conducting the operating-current to the vehicle-propelling motor or motors; but in order to make the switches reliable in operation this construction has usually been complicated to such an extent as to materially increase the expense of installation beyond what is desirable—as, for example, by providing either electromagnetic or mechanical means for interrupting the pick-up circuit when the main circuit is closed. I propose to avoid the necessity of interrupting such circuit by connecting one terminal of the pick-up coil with the ground through a high resistance. This resistance permits sufficient current to pass to effect the closing of the circuit when no other path is provided for it, but precludes the shunting through it of sufficient current to involve any material loss.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram of a section of roadway, a railway-vehicle, the switches, and electric circuits. Figs. 2 and 3 are diagrams of modified forms of switches. Fig. 4 is a vertical section of one of the switches illustrated diagrammatically in Fig. 1. Fig. 5 is a plan view of the switch shown in Fig. 4, looking downward; and Fig. 6 is a corresponding view of the bottom, looking upward. Fig. 7 is a detail sectional view of one of the movable shunt-contacts.

Referring particularly to Fig. 1, 1 and 2 are the track-rails, and 3 are the roadway-contacts, which are normally insulated from each other and from the feeder 4. The roadway-contacts are shown in the form of rail-sections; but the operation of the system will be substantially the same if they are in the form of more widely separated buttons or plates. The only variation necessary in the system for such construction would be in the form of the contact-shoe. The shoe 5 is in the present instance shown as made in two parts connected by a suitable conductor, this arrangement being employed in order that a considerable space may be bridged by the device. The motors 6 will be geared to the truck-wheels of the car and connected in circuit with suitable controlling apparatus, as is usual and well understood in the art.

7 is a rotary transformer connected at one side to a secondary battery 8 and at the other side to the shoe 5 and the track-rails, as is usual.

The arrangement is intended to be such that the comparatively small electromotive force of the storage battery will be raised by the rotary transformer to approximately the working voltage of the system, so that substantially the working voltage may be utilized in closing the switches.

I have shown three forms of circuit making and breaking switch in Fig. 1, the switch *a* (shown at the left in said figure) comprising a main contact-piece 9^a and an auxiliary contact-piece 9^b, permanently connected to the feeder 4, and corresponding contact-pieces 9^c

and 9^d, permanently connected to ground through a high-resistance conductor 10 and to one terminal of a low-resistance magnet-coil 11, the other terminal of said coil being permanently connected to one of the roadway-contacts 3. The coil 11 is inclosed in an iron casing 12 and is provided with a movable core 13, which is connected to the movable member 14 of the switch by means of a rod 15. The member 14 is provided with main and auxiliary contact-pieces 14^a, 14^b, 14^c, and 14^d, that respectively coöperate with the stationary pieces 9^a, 9^b, 9^c, and 9^d, as is usual in this class of devices. A dash-pot 16 may also be provided in order to prevent the switch from opening when the current is reversed in the coil 11; but this will not be necessary if the core 13 is provided with a chamber that is suitable for properly coöperating with the core to effect a similar function.

When the contact-shoe 5 comes into engagement with the roadway-contact 3 corresponding to switch *a*, current from the rotary transformer 7 will pass through coil 11 and the high-resistance conductor 10 to ground, the resistance of the latter being such that only a small quantity of current will pass through it. The coil 11 thus energized will close the switch and current will flow from the feeder 4 through the parts 9^a 14^a 14 14^c 9^c and coil 11 to the motors, the high-resistance ground connection being thus shunted and the switch held closed until the shoe 5 breaks connection with the contact 3 which corresponds to said switch.

Each of the switches a' and a^2 differs from the switch *a* in having a high-resistance pick-up coil 11^b, through which current passes to ground from either the rotary transformer 7 or the preceding roadway-contact and which is short-circuited through low-resistance coil 11^a when the switch is closed. The coil 11^b is also connected in circuit between the feeder 4 and the motors when the switch is closed by means of contact-pieces 17; but it is obvious that very little, if any, current will pass therethrough.

It will be observed that switches a' and a^2 are alike in construction, but differ as regards circuits in that the path to the ground in the former is around coil 11^a, while in the latter the path is through such coil.

Switches a' and a^2 are preferable to switch *a* in systems employing heavy currents, since most of the large number of turns necessarily employed in connection with the comparatively small secondary-battery current for closing the switch are short-circuited by the working current instead of being retained in the main circuit, as is the case in switch *a*.

Referring now to Fig. 2, the magnet of switch a^3 is provided with a coil 18, comprising a comparatively short low-resistance portion 18^a and a comparatively long high-resistance portion 18^b, the feeder 4 being connected to the free terminal of the portion 18^a by a conductor 19 and the free terminal of the portion 18^b being connected to one stationary contact 20 of an initially-acting auxiliary switch a^5, hereinafter designated as the "initial" switch. The iron casing 12 has a middle partition 12^a, which is located between the coil 18 and a high-resistance coil 21, and therefore insures approximately independent magnetic circuits for these coils. The stationary contacts 9^a and 9^b of the main switch are connected to coil 18 between the sections 18^a and 18^b by conductor 22, and the other stationary contacts 9^c and 9^d of the main switch are connected to the corresponding roadway-contact 3 by a conductor 23. The terminals of the coil 21 are connected, respectively, to the conductor 23 and to the ground through the high-resistance conductor 10. This coil is also connected to the stationary contact 20^a of the initial switch. The movable contacts 14^a, 14^b, 14^c, and 14^d of the main switch are connected by a bridge 14, and this is connected by means of a rod 24 to a core 25, located above the partition 12^a and within the magnetic field of the coil 18. The movable contacts 26 and 26^a are also connected by a bridge 27, and the latter is supported by the core 28 for the coil 21. A coiled spring 29 is preferably interposed between the two members 14 and 27.

The contacts 9^b, 9^d, 14^b, 14^d, 20, 20^a, 26, and 26^a are preferably formed of carbon or of some other substantially infusible material, while the other switch-contacts are made of metal in order to provide a path of low resistance for the main current, the final break being made by the small supplemental carbon contacts 9^b, 9^d, 14^b, and 14^d.

The switch a^4 (shown in Fig. 3) differs from switch a^3 only in having a single low-resistance coil 18 in the upper portion of the magnet.

The operation of the system where switches like switch a^3 are employed is as follows: Assuming that all the switches are open and the shoe 5 comes into engagement with the roadway-contact corresponding to a given switch, the current from the secondary battery 7 will pass through the shoe 5, the roadway-contact 3, with which it is in engagement, the conductor 23, coil 21, and resistance 10 to the ground. This current will energize the coil 21 sufficiently to raise the member 27 of the initial switch, thus closing the circuit from the feeder 4 through the sections 18^a and 18^b of the coil 18, the contacts 20 26 26^a 20^a, the coil 21, and conductor 23 to the roadway-contact 3 through the shoe 5, the controlling devices, (not shown,) and the motors to the track-rails and ground. This current will energize the coil 18 sufficiently to effect the closing of the main switch, and when this is effected both the coil 21 and the coil-section 18^b

will be short-circuited, thus leaving but very small resistance in the main circuit, the coil-section 18^a being of comparatively large wire and few turns. In this form of switch all of the turns in coil 18 are utilized for closing the main switch, while only the short length 18^a of low-resistance wire is included in the main circuit during the time that the main switch is closed.

The operation of the switch a^4 is substantially the same as that already described except that the entire coil 18 is retained in the main circuit during the time that the main switch is closed. As the direction of current flow through the coil 21 is reversed when the switch is closed, the core should be so combined with the stationary part of the magnet as to have a dash-pot effect to prevent the opening of the switch at the reversal of the magnetism or a separate dash-pot provided, as is indicated in connection with switch a. Inasmuch as it is feasible to so construct the cores as to effect this result it has not been deemed necessary to illustrate a separate dash-pot in connection with each switch. The spring 29 between the movable switch members obviously tends to insure independent operation of such members.

If from any cause the work-current should not be heavy enough to either close or maintain closed the main switch shown in Fig. 2 or that shown in Fig. 3, the initial switch a^5 will serve to carry such current until its volume is sufficient to effect the closing of the main switch.

The construction of the switch illustrated in Figs. 4 to 7 has been already sufficiently described except as regards the carbon shunt-contacts, one of which is shown in detail in Fig. 7. It will be seen by reference to this figure that each of these contacts rests upon a spiral spring 30, which tends to force it upward, so that when the movable member of the switch drops by the action of gravity the shunt-contacts will be held in engagement after the main metal contacts are separated, thus guarding against any possible injury to the metal contacts by the interruption of the circuit.

I desire it to be understood that the auxiliary shunt-contacts 9^b, 9^d, 14^b, and 14^d are not essential to my invention, since the main contacts may be formed of carbon and the auxiliary contacts omitted, if desired. One pair of contacts 17 instead of two may also be employed in switch a'. It will be understood, also, that when the first switch of the system has been closed by the action of the current from the rotary transformer 7 the subsequent switches may be closed by the action of current from the feeder 4 inasmuch as the shoe 5 is of sufficient length to bridge over the roadway-contact in advance of that which is immediately under the car and supplying current to the motors.

I claim as my invention—

1. A system of distribution for electric railways comprising a feeder, a single line of roadway-contacts normally insulated from said feeder and from each other, and a series of electromagnetically-actuated circuit making and breaking switches each of which embodies a coil having a low-resistance connection at its respective ends with one of the roadway-contacts and with one of the switch-contacts and having a permanent high-resistance connection to ground.

2. A system of distribution for electric railways comprising a feeder, a single line of roadway-contacts normally insulated from the feeder and from each other and a series of electromagnetically-actuated switches, each of which is provided with a high-resistance coil having a low-resistance connection at its respective ends with one of the roadway-contacts and with one of the switch-contacts and a permanent high-resistance connection to ground, and a low-resistance coil having its terminals respectively connected to one of the roadway-contacts and to one of the switch-contacts.

3. In a system of distribution for electric railways, a feeder and a single line of roadway-contacts, in combination with a series of circuit making and breaking switches each of which comprises a high-resistance coil intermediate a roadway-contact and a switch-contact and having a high-resistance connection to ground, and a low-resistance coil intermediate the feeder and a plurality of switch-contacts, whereby the high-resistance coil is short-circuited when the main circuit is closed.

4. An automatic circuit making and breaking switch for electric railways comprising two independently-movable members, a coil having a permanent high-resistance connection to ground for initially actuating one of said members and a second coil for actuating the other of said members, the energizing of said second coil being dependent upon the positive movement of said first switch member.

5. An automatic circuit making and breaking means for electric railways comprising a coil connected permanently to ground through a high resistance, a switch actuated thereby, a second or main switch and an actuating-coil therefor, the circuit of which is closed by the first-named switch.

In testimony whereof I have hereunto subscribed my name this 23d day of February, A. D. 1898.

L. M. ASPINWALL.

Witnesses:

WESLEY G. CARR,

H. C. TENER.