No. 776,371. PATENTED NOV. 29, 1904.

W. J. ALEXANDER.

ELECTRICAL RAILWAY SYSTEM.

APPLICATION FILED MAY 18, 1904.

NO MODEL. 3 SHEETS—SHEET 1.

Fig 1.

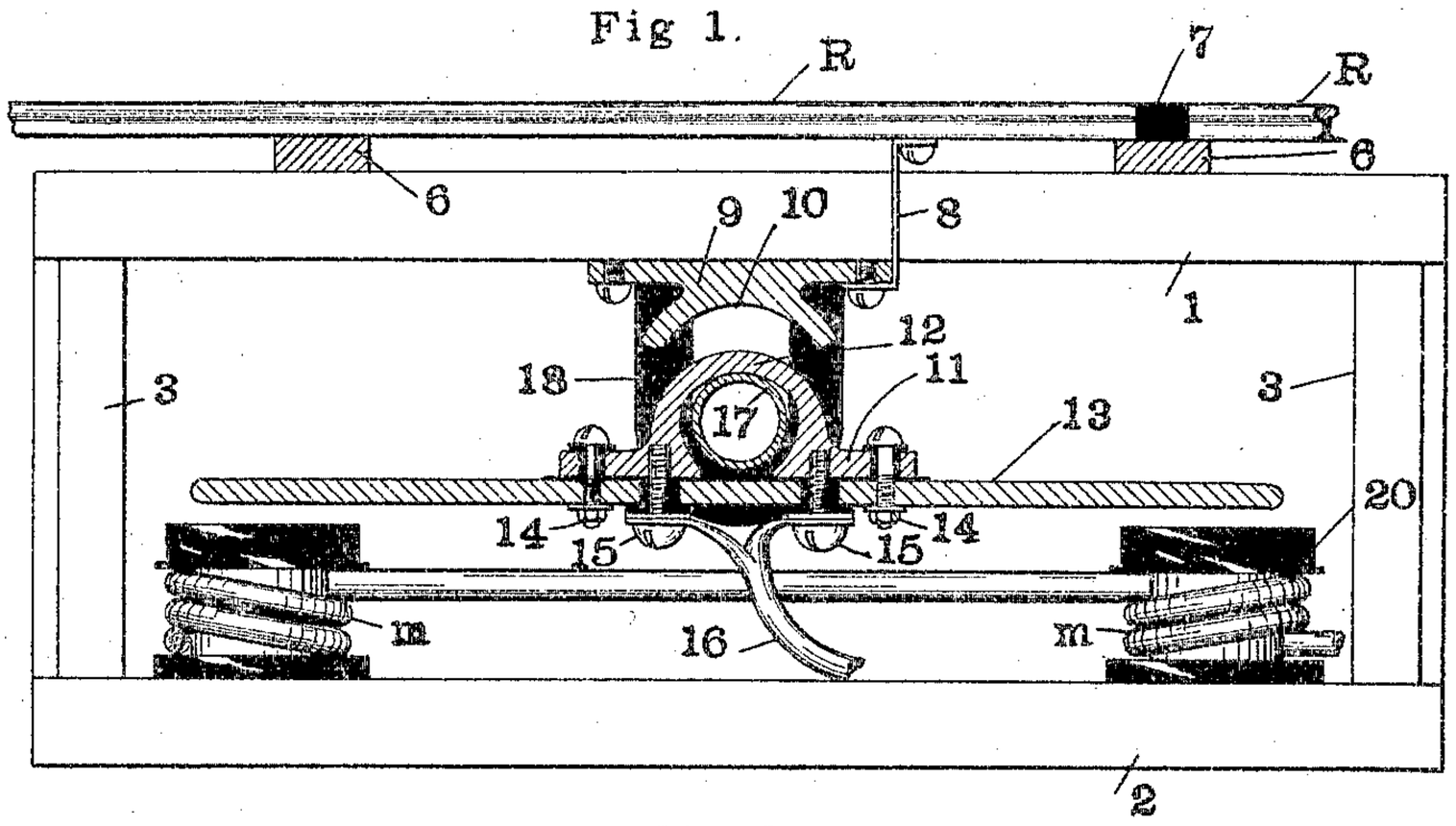


Fig 2.

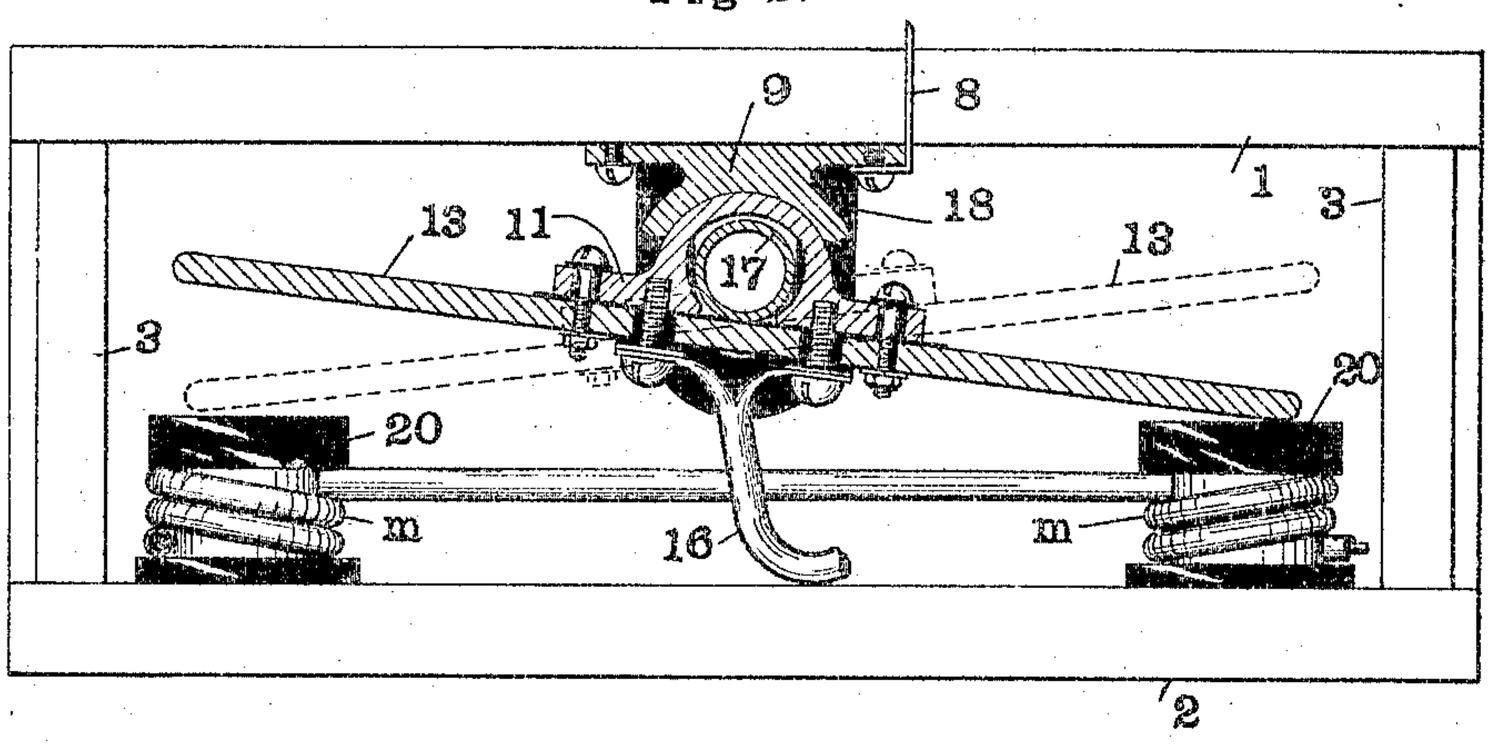
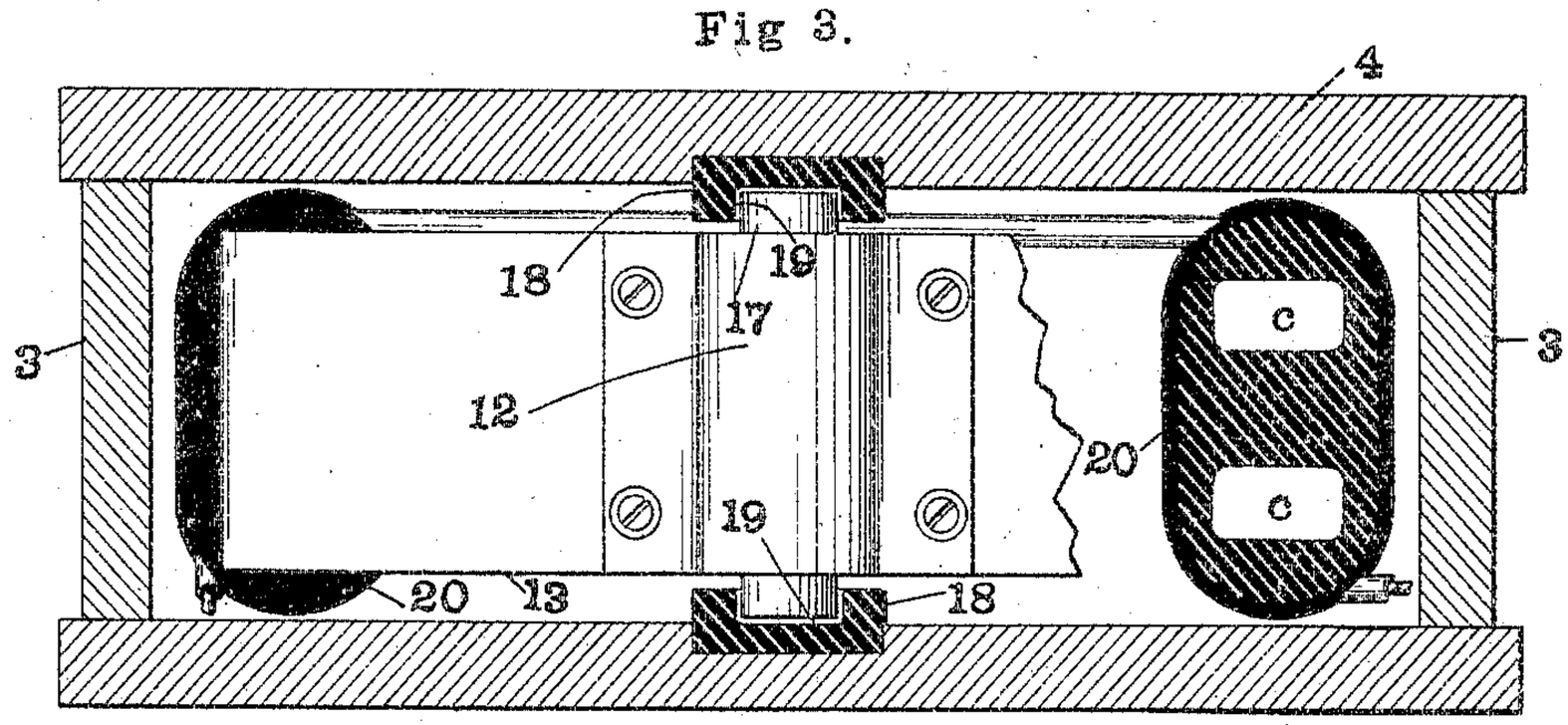


Fig 3.



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NO MODEL. 3 SHEETS—SHEET 2.

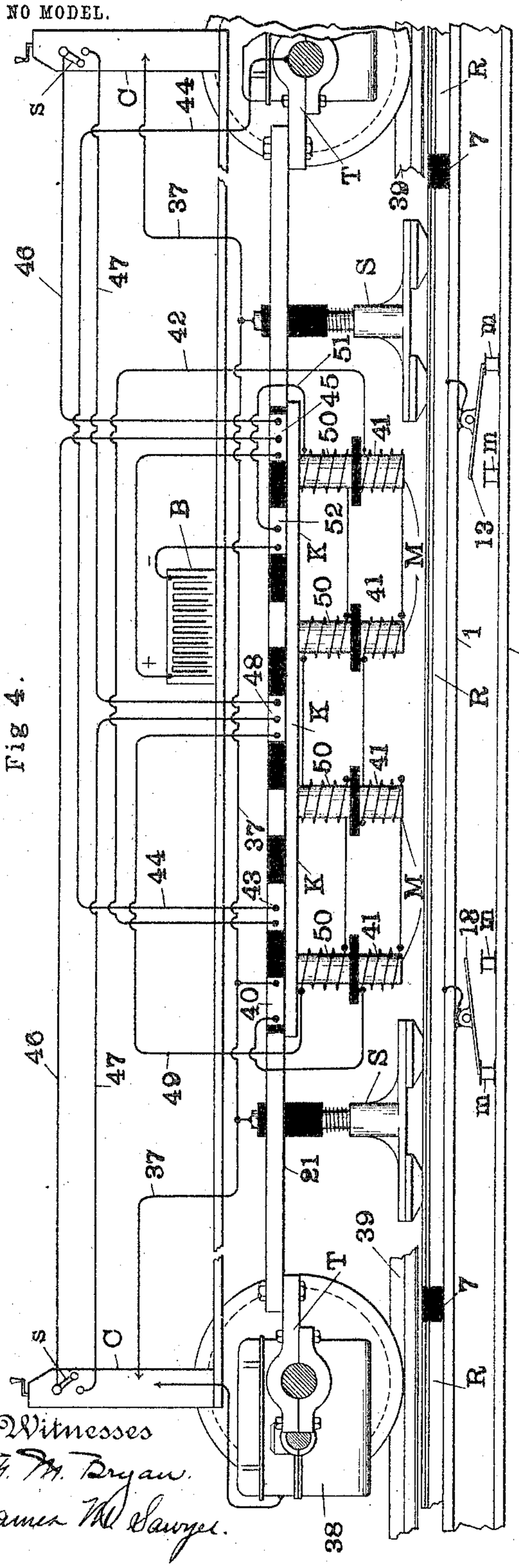

Fig 4.

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ELECTRICAL RAILWAY SYSTEM.

APPLICATION FILED MAY 18, 1904.

NO MODEL. 3 SHEETS—SHEET 3.

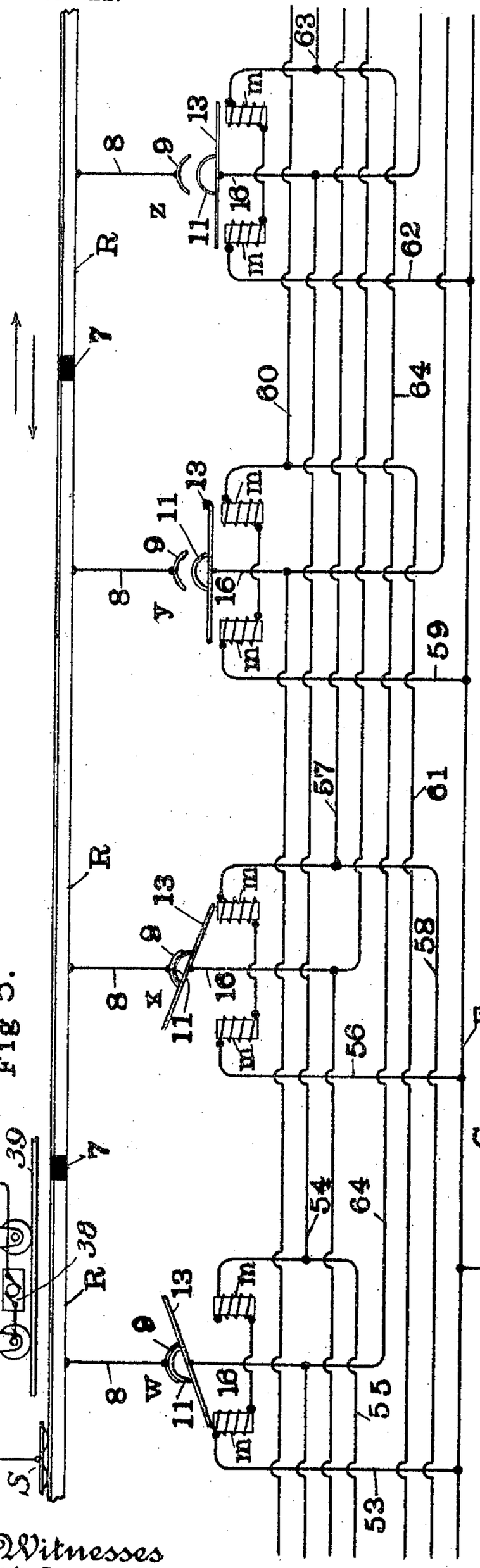

Fig 5.

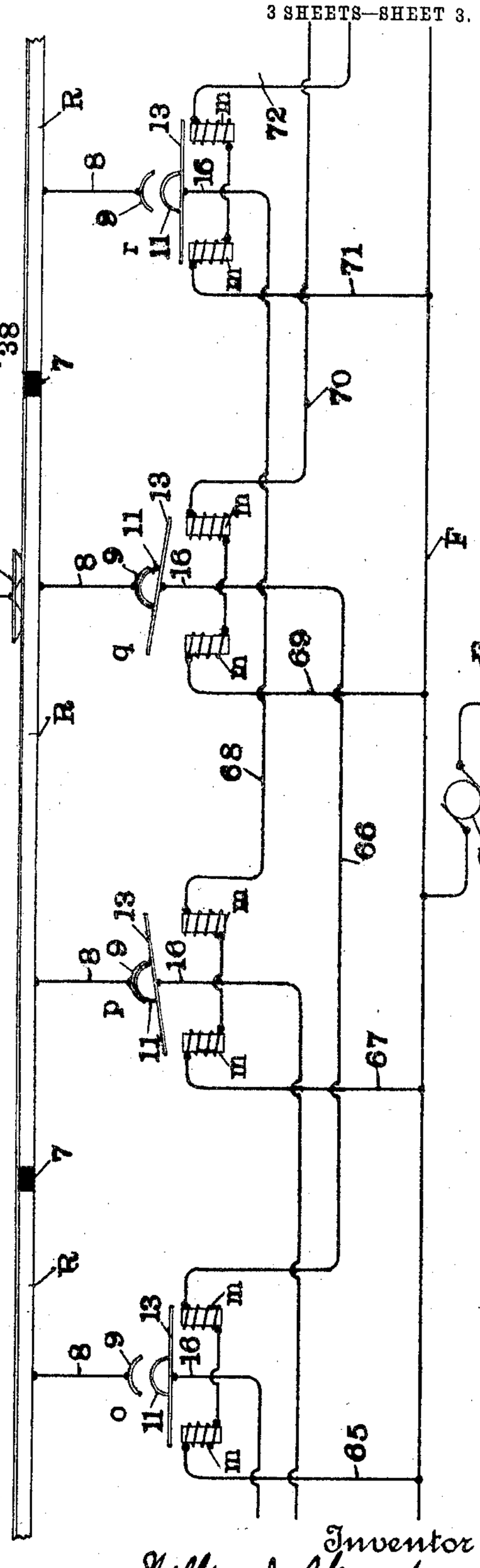

Fig 6.

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No. 776,371. Patented November 29, 1904.

UNITED STATES PATENT OFFICE.

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ELECTRICAL-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 776,371, dated November 29, 1904.

Application filed May 18, 1904. Serial No. 208,528. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM J. ALEXANDER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Electrical-Railway System, of which the following is a specification.

My invention relates to electrical-railway systems, more especially those in which a sectional rail is employed in association with automatic electric switches for putting that section of the contact-rail immediately beneath the car or train into communication with the feeder-conductor and for insuring the disconnection of the sections just passed over by the car or train.

My invention consists also of an automatic electric switch for use in a system as above described or in other systems, such switch comprising an armature member carrying a contact member, such armature being normally loosely pivoted and attracted to circuit-closing position by a magnet or magnets upon the car or train, such switch comprising also electromagnetic means for positively opening the same in case of failure to open by gravity. The disposition of the armature is such that as a car moves over and passes a switch said armature rocks or tilts, causing a rubbing of the contacts, whereby such contacts are maintained bright and clean.

My invention consists also of other features of circuit connections and structures hereinafter described, and pointed out in the claims.

Reference is to be had to the accompanying drawings, in which—

Figure 1 is a side view of the switch, partly in section. Fig. 2 is a view similar to Fig. 1, showing the switch in circuit-closing position. Fig. 3 is a plan view of the switch, partly in section. Fig. 4 is a diagrammatic view showing the car-circuits, &c. Fig. 5 is a diagrammatic view of the circuits and sectional rail for a single-track road over which cars or trains may pass in either direction. Fig. 6 is a diagrammatic view of the circuits and sectional rail for a track over which the cars or trains run principally in one direction only.

Referring to the drawings, 1 is the top plank or wall of a conduit or the like containing the automatic switches and extending along the track either between the rails or on either side of them.

2 is the bottom planking or wall of the conduit, and 3 is a transverse partition dividing the conduit up into compartments.

4 and 5 represent the side walls of the conduit.

On cross-timbers 6 on the top of the conduit is laid the sectional rail R, sections being separated from each other by insulating-blocks 7.

8 is a heavy conductor secured at one end to a section of the rail R and at its other end to the contact 9, secured to the under side of the member 1.

10 is the active face of the contact 9 and is a portion of the surface of a cylinder machined true. 11 is the coöperating contact, whose active surface 12 is machined to fit accurately the contact-surface 10. The contact-piece 11 is secured to the armature member 13 by means of bolts or screws 14, but is insulated from said armature. By means of screws 15 a flexible conductor 16 is secured to the contact-piece 11, but likewise insulated from the armature 13.

The armature 13 consists of a plate of soft iron or steel arranged with its length or longest dimension parallel with the track. In normal position, as shown in Fig. 1, it is balanced on the pivot member 17, which may be a tube of brass or any other suitable material located within and supporting the contact-piece 11. The opening within the contact-piece 11 is much larger than the external diameter of the pivot member 17, with the result that the armature 13 is poised or loosely pivoted in a position from which it is easily moved, as hereinafter described.

Set in each of the side walls 4 and 5 is a member 18, of insulating material, such as porcelain or the like. Each of these insulators has a downwardly-extending recess or slot 19 to accommodate the free vertical movement, a motion of translation as distinguished from

rotary motion, of the pivotal member 17, whose ends engage in these vertically-extending slots 19. In effect, therefore, the members 18 are vertical guides for the member 17.

On the car or train is located a magnet or magnets M, (hereinafter described,) whose function is to lift the armatures 13 of the automatic switches to bring the coöperative contacts 9 and 11 into engagement. In Fig. 2 the parts are shown with the armature 13 in the attracted position. Supposing the car to be moving from the left toward the right as viewed in Fig. 2, the magnet M first approaching the left end of the armature 13 tilts such armature on the pivot member 17 until the right end touches the insulating material 20, located on the magnets, to be hereinafter described. With the right end of the armature 13 as a fulcrum the armature 13 is lifted to the position shown in Fig. 2, thus bringing the contact-piece 11 into engagement with the contact-piece 9, thereby establishing electrical communication between the conductor 16 and a section of the rail R. The member 17 has also been lifted but no longer operates as a pivotal member when the armature 13 is in attracted position. As the magnet on the car advances toward the right the armature 13 remains in the attracted position, but rotates first into a horizontal position and then into the dotted-line position, Fig. 2. This rotation of the armature 13 while in attracted position is accompanied by the rotation of the contact-piece 11 upon the contact-piece 9, and this rotation occurring during each closure of the switch insures the contact-surfaces of 9 and 11 maintaining each other bright and clean.

The contact-pieces 9 and 11 extend transversely to the track and from their structure, whereby they engage each other over a relatively great arc, provide ample contact-surface for handling the heaviest current employed on electrical railroads. The contacts 9 and 11 are preferably made of good conducting material, such as brass or copper; but the composition of the contact-pieces of a pair should be different. I have found that with the contacts of a pair being of dissimilar composition blistering, roughening, or burning is greatly reduced. To this end the contact-piece 9 may be of copper, while the piece 11 may be of brass, or the piece 9 may be of one quality of brass, while the contact-piece 11 may be of another quality of brass.

Located upon the bottom wall or plank 2 are a pair of electromagnets *m m*, one arranged under each end of the armature 12. Each of these magnets is covered and surrounded by insulating material 20. Each magnet comprises the two cores *c c*, embedded in the insulating material, and around the insulating material is wound the magnetizing-coil. When a current passes through these windings or coils, the cores *c c* are energized and pull the armature 13 downward from its attracted position, thus assisting gravity to restore the parts to the position shown in Fig. 1, or in case of any sticking to overcome such sticking and to insure the opening of the switch independently of gravity.

Referring to Fig. 4, T T represent the trucks of the car, extending between which is the bar 21, carrying the magnets M and the contact-shoes S.

There are two automatic switches, as shown in Fig. 4, for each section of the rail R, the arrangement being such that both may be in circuit-closing position when the car is in the position shown in Fig. 4, and that the car may advance part way the length of the succeeding section of the rail R, while one of the automatic switches remains in circuit-closing position.

The current is collected from the rail R by the shoes S and passes through conductor 37 and either controller C to the motor 38, thence to the car-axle, to the trucks and wheels, and to the track-rail 39. Conductor 37 communicates also with plate 40, to which is secured one terminal of the winding 41 of the magnets M, the other terminal communicating, by means of conductor 42, with the plate 43, to which is connected the conductor 44, leading to the track-rail 39 through the car-axle. The windings 41 are therefore potential windings connected in series with each other and connected directly between the sectional rail and the track-rail. The magnets M, having the yokes K, serve to attract the armatures 13 of the automatic switches, as heretofore described. In case the shoes S are in contact with dead sections of the rail R and it is desired to render such sections alive so that the car may proceed the storage battery B is carried by the car for the purpose of temporarily energizing the magnets M. For this purpose the motorman closes the switch *s*, which then permits current to flow from the positive, for example, pole of the battery B to the plate 45, and thence by conductors 46 and 47 to the plate 48, and thence by conductor 49 through the auxiliary windings 50 on the magnets M, and thence by conductor 51 to plate 52 to the negative side of the battery. The magnets M thus become energized and pick up the armature 13 of at least one switch, the magnets M being distributed along the length of the car in such manner or at such intervals with regard to the distribution of the automatic switches that at least one armature 13 will be within the field of at least one of the magnets M. With the attraction of one armature 13 a section of the rail R becomes alive and the car may proceed, the magnets M being thereafter energized by the windings 41, the circuit of the winding 50 being then interrupted by opening the switch *s*.

Referring to Fig. 5, G represents the generator supplying the electrical energy for driving the cars or train. One pole of the

generator is connected to the earth E or track-rail 39 and the other pole is connected to the feeder-conductor F. Four automatic switches *w*, *x*, *y*, and *z*, similar to the one illustrated in Fig. 1, are shown. The windings of magnets *m m* of switch *w* communicate by conductor 53 with the feeder-conductor F and by conductor 54 with the conductor 16 and contact-piece 11 of the switch *z* and by conductor 55 with the contact-piece 11 of the third switch to the left. (Not shown.) Similarly the windings of magnets *m m* of the switch *x* are connected by conductor 56 with the feeder F and by conductor 57 with the contact-piece 11 of the third switch to the right (the first beyond *z*) and by conductor 58 with the contact-piece 11 of the third switch to the left. (Not shown.) Similarly the windings of the magnets *m* of the switch *y* connect with feeder F through conductor 59, and through conductor 60 with the contact-piece 11 of the third switch to the right, (not shown,) and by means of conductor 61 with the contact-piece 11 of the third switch to the left. (Not shown.) Similarly the windings of the magnets *m m* of the switch *z* connect with the feeder F through the conductor 62 and by means of conductor 63 with the contact-piece 11 of the third switch to the right (not shown) and by means of the conductor 64 with the contact-piece 11 of the switch *w*, which is the third switch to the left. It is thus seen that the contact-piece 11 of each of the switches is connected to the feeder F through the windings of two other switches, one being the third switch to the left and the other the third switch to the right. The effect of this is to energize the magnets *m m* of the third switch ahead and the third switch to the rear, causing those distant switches to open positively. Thus while the switch *x* is closed and the car is receiving current therethrough the third switch ahead and the third switch to the rear is positively opened by the current flowing through the switch *y*. Furthermore, the disposition of the switches and the magnets on the car is such that two neighboring switches are always closed, as *w* and *x*, these switches opening in succession as the car passes from them. Suppose the car to be going toward the right as viewed in Fig. 5, the armature 13 and parts attached thereto will drop by gravity as soon as the car has passed and there will be no arcing between the contact-pieces 9 and 11, because the switch *x* is still closed and will effectually shunt the switch *w* to prevent all arcing. If, however, the switch *w* should stick in closed position, the armature 13 would be pulled down positively by the magnets *m m* as soon as the car has reached a position over the third switch to the right—namely, switch *z*. From this it is seen that cars may travel in either direction over the track when the circuit arrangements are those shown in Fig. 5.

For a double-track road—that is, where cars or trains pass always in the same direction over a track—the circuit arrangements may be simplified in accordance with Fig. 6. In this figure G represents the generator, E the earth or track-rail connection, and F the feeder-conductor. Four automatic switches *o p q r* are shown. The windings of the magnets *m m* of the switch *o* connect with the feeder F by conductor 65 and by conductor 66 with the contact-piece 11 of the switch *q*, the second switch in advance. Similarly a conductor 67 joins feeder F with the windings of the magnets *m m* of the switch *p*, the other terminal of such windings being connected by conductor 68 with the contact-piece 11 of the switch *r*, the second switch in advance. The windings of the magnets *m m* of the switch *q* connect with feeder F by means of conductor 69 and by means of conductor 70 with the contact-piece 11 of the second switch in advance. (Not shown.) The windings of the magnets *m m* of the switch *r* connect, through conductor 71, with feeder F and by means of conductor 72 with the contact-piece 11 of the second switch in advance. (Not shown.) From this arrangement it is seen that each switch receives its current when closed through the windings of the magnets of the second switch to the rear. Since two switches are beneath the car, the switch last passed over is positively opened, if it has not already opened by gravity, by the current passing through the switch that has just been closed by the magnets on the car.

From the foregoing descriptions of Figs. 5 and 6 it is seen that only those sections of the contact-rail are alive which are either entirely or partly covered by the car or train. The length of the sections R of the contact-rail may be varied to suit the various lengths of the car or train employed, and the number of switches for each section of the contact-rail may be varied.

This system is equally well adaptable to the systems of multiple unit control, in which case the sections of the rail R may be maintained short so as to be practically covered by a single car, or may be very long so as to be covered only by a number of cars.

Conductors F and the conductors between the automatic switches may be laid in a separate conduit or within the same conduit or boxing containing the automatic switches.

What I claim is—

1. In an electrical-railway system, a sectional contact-rail, a feeder, an electrical switch intermediate said feeder and a section of said contact-rail, a motor-car, means upon said car for closing said switch and causing the contacts to move upon each other during engagement, and an electromagnet for insuring the opening of said switch, the winding of said magnet being in series between said feeder and a distant section of said sectional rail.

2. In an electrical-railway system, a sectional contact-rail, a motor-car, a feeder, a switch intermediate said feeder and a section of said contact-rail said switch having contacts of dissimilar material, means on said car for closing said switch and causing the contacts to move upon each other during engagement, and an electromagnet whose winding is connected in series between said feeder and a distant section of said rail, whereby said switch is positively opened when said car is receiving the current from said distant section of said rail.

3. In an electrical-railway system, a motor-car, a sectional rail, a feeder, a switch intermediate said feeder and a section of said rail, said switch having contacts of dissimilar metals, means upon said car for bringing said contacts into engagement, and an electromagnet for insuring the opening of said switch, the winding of said magnet being connected in series between said feeder and a distant section of said sectional rail.

4. In an electrical-railway system, a motor-car, a sectional contact-rail, a feeder, a switch intermediate said feeder and a section of said rail, said switch having coöperating contacts of dissimilar materials, means on said car for bringing said contacts into engagement and for causing said contacts to rub upon each other while in contact for maintaining the contact-surfaces clean, and an electromagnet for insuring the opening of said switch when the car has passed to a distant section.

5. In combination, a track, a sectional conductor, a feeder, and a switch intermediate said feeder and a section of said conductor, said switch comprising a stationary contact and a movable contact loosely pivoted upon a member extending transversely of said track, and means permitting motion of translation of said member, whereby said contacts may engage each other.

6. In combination, a track, a sectional conductor, a feeder, and a switch intermediate said feeder and a section of said conductor, said switch comprising a fixed contact, a magnetizable member extending parallel with said track, a movable contact secured to said magnetizable member, a member on which said magnetizable member is balanced, and means permitting motion of translation of said last-mentioned member.

7. In combination, a track, a sectional conductor, a feeder, and a switch intermediate said feeder and a section of said conductor, said switch comprising coöperating cylindrical contacts, a moving contact being secured to a magnetic member extending parallel with said track, a member on which said magnetic member is balanced, and means permitting motion of translation of said last-mentioned member and said magnetic member.

8. In an electric switch, a stationary contact, a movable contact, an armature secured to said movable contact, and means for operating said armature to bring said contacts into engagement with each other, said armature being loosely pivoted on a member, and means for guiding said member in a motion of translation when said armature is operated.

9. In an electric switch, a stationary contact and a movable contact, said contacts engaging each other over a cylindrical surface, an armature for operating said movable contact, a member on which said armature is loosely mounted, means for permitting motion of translation of said member, and means for operating said armature to cause said contacts to engage and thereafter rub upon each other to maintain the contact-surfaces bright.

10. In an electric switch, a fixed contact, a movable contact, said contacts being of dissimilar materials, a loosely-mounted armature supporting said movable contact, and means for operating said armature to bring said contacts into engagement and thereafter move upon each other to maintain the contact-surfaces bright.

11. In an electric switch, a fixed contact, a movable contact, said contacts being of dissimilar materials and adapted to engage each other on cylindrical surfaces, a loosely-mounted armature supporting said movable contact, and means for actuating said armature to cause said contacts to engage and thereafter rotate upon each other.

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