No. 662,419. Patented Nov. 27, 1900.

W. GRUNOW, JR.

ELECTRIC RAILWAY.

(Application filed Apr. 5, 1900.)

(No Model.) 4 Sheets—Sheet 1.

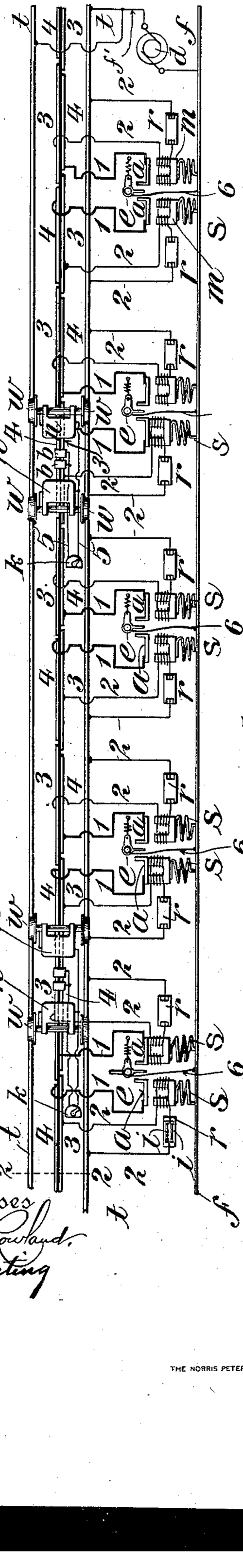


Fig. 1.

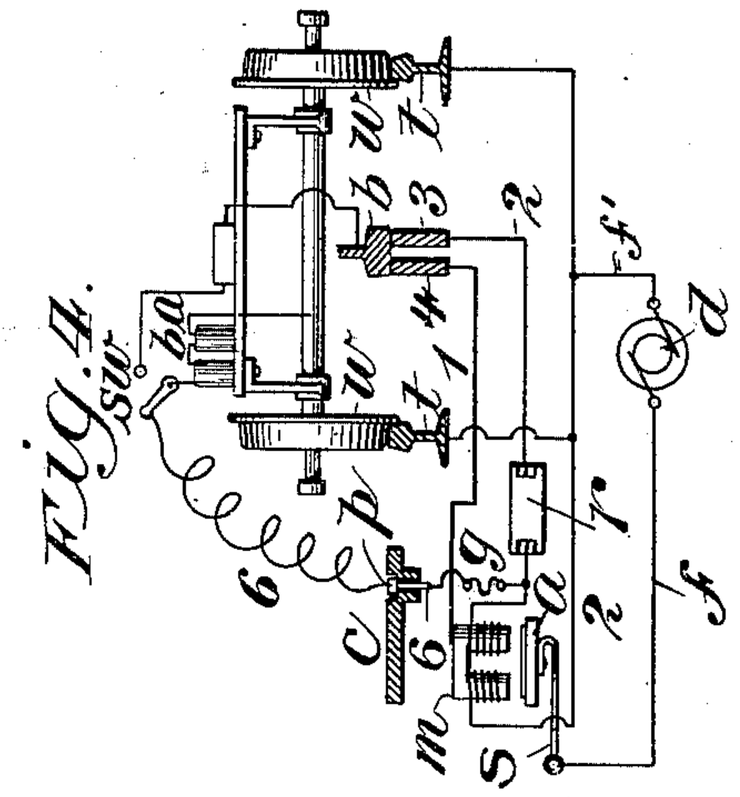


Fig. 4.

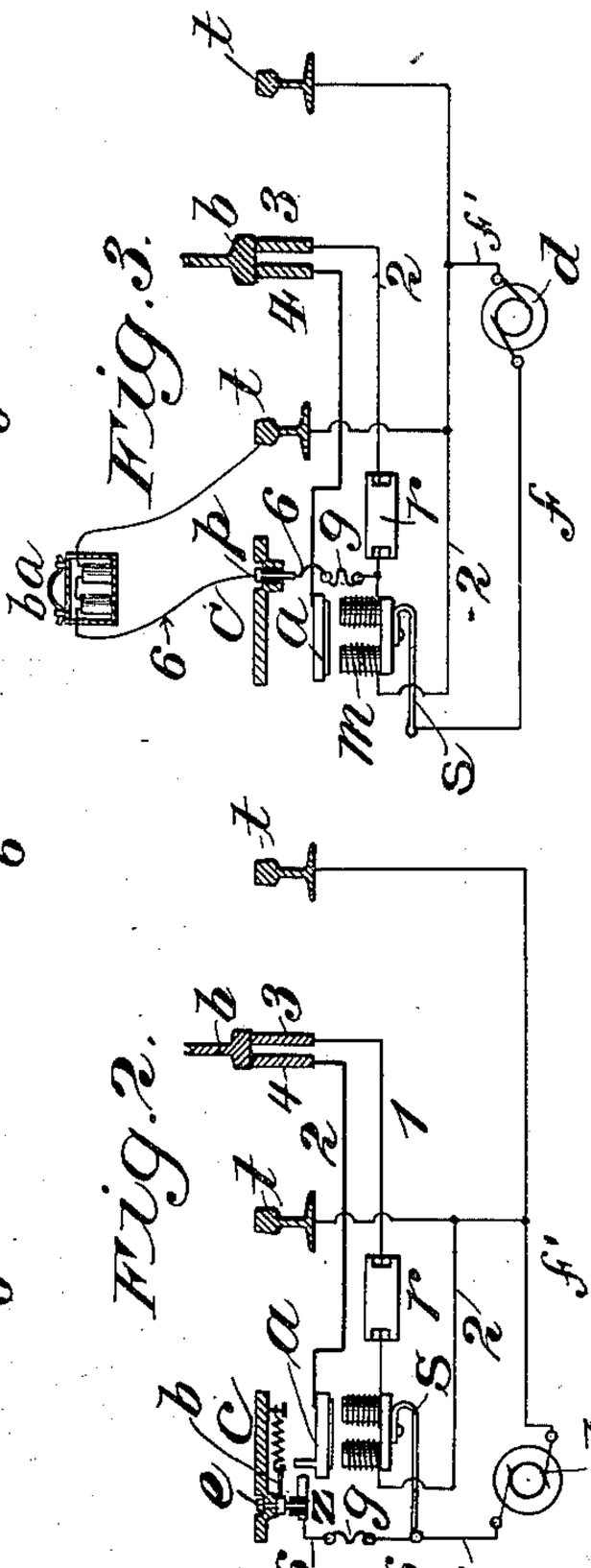


Fig. 3.

Fig. 2.

Witnesses
Edward C. Rowland.
M. F. Keating

Inventor
William Grunow Jr
By his Attorney
Charles J. Kintner

No. 662,419. Patented Nov. 27, 1900.

W. GRUNOW, JR.

ELECTRIC RAILWAY.

(Application filed Apr. 5, 1900.)

(No Model.) 4 Sheets—Sheet 2.

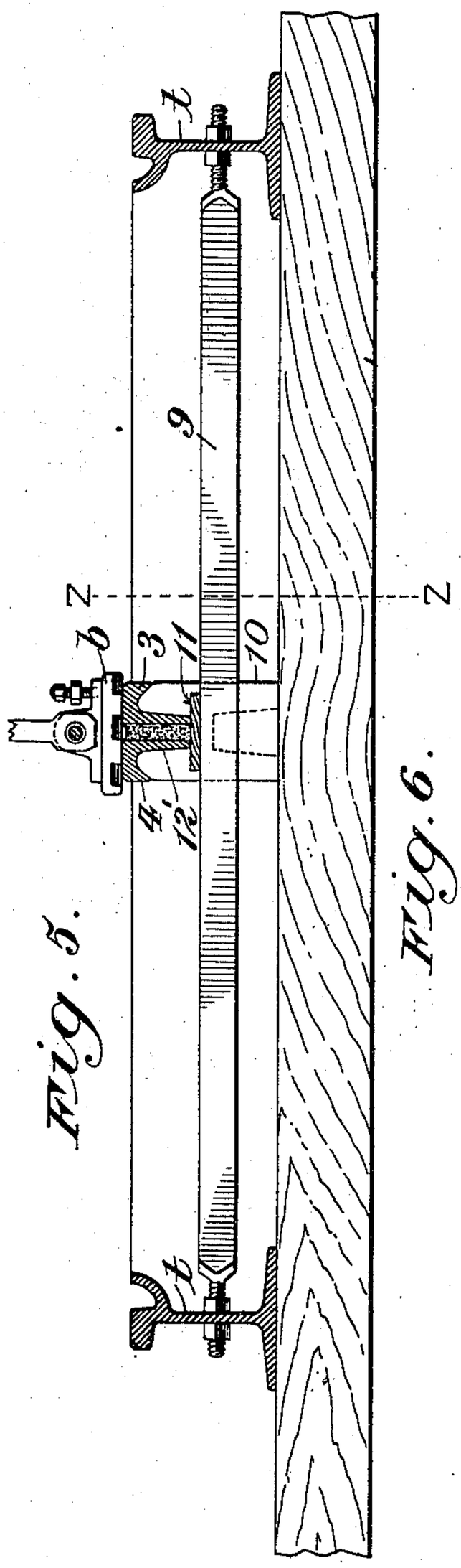


Fig. 5.

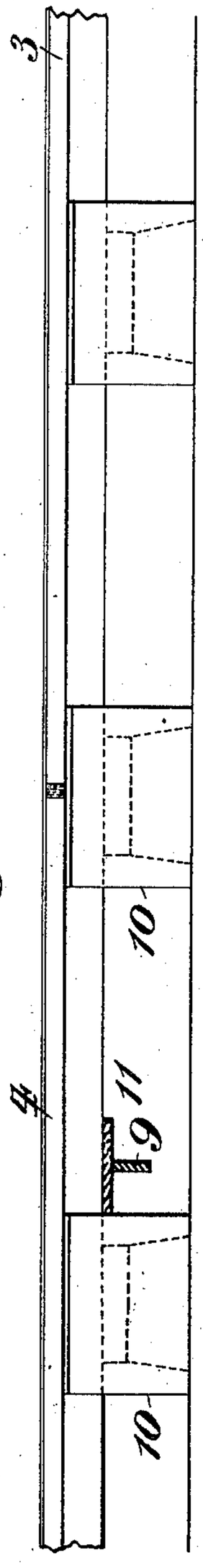


Fig. 6.

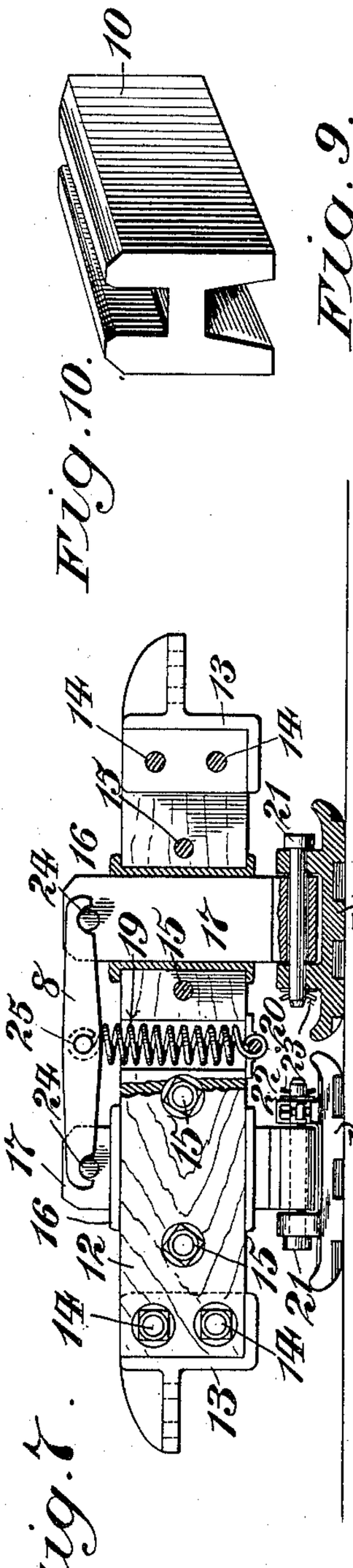


Fig. 7.

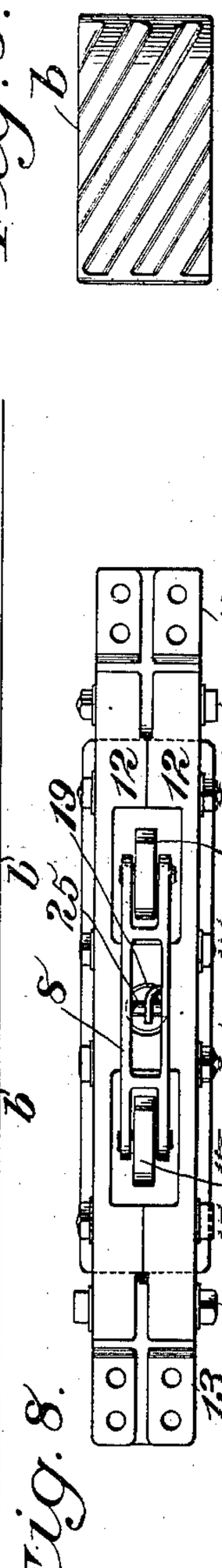


Fig. 8.

Fig. 10.

Fig. 9.

Witnesses
Edward C. Rowland
H. F. Keating

Inventor
William Grunow Jr
By his Attorney
Charles J. Kintner

No. 662,419. Patented Nov. 27, 1900.

W. GRUNOW, JR.

ELECTRIC RAILWAY.

(Application filed Apr. 5, 1900.)

(No Model.) 4 Sheets—Sheet 3.

Fig. 11.

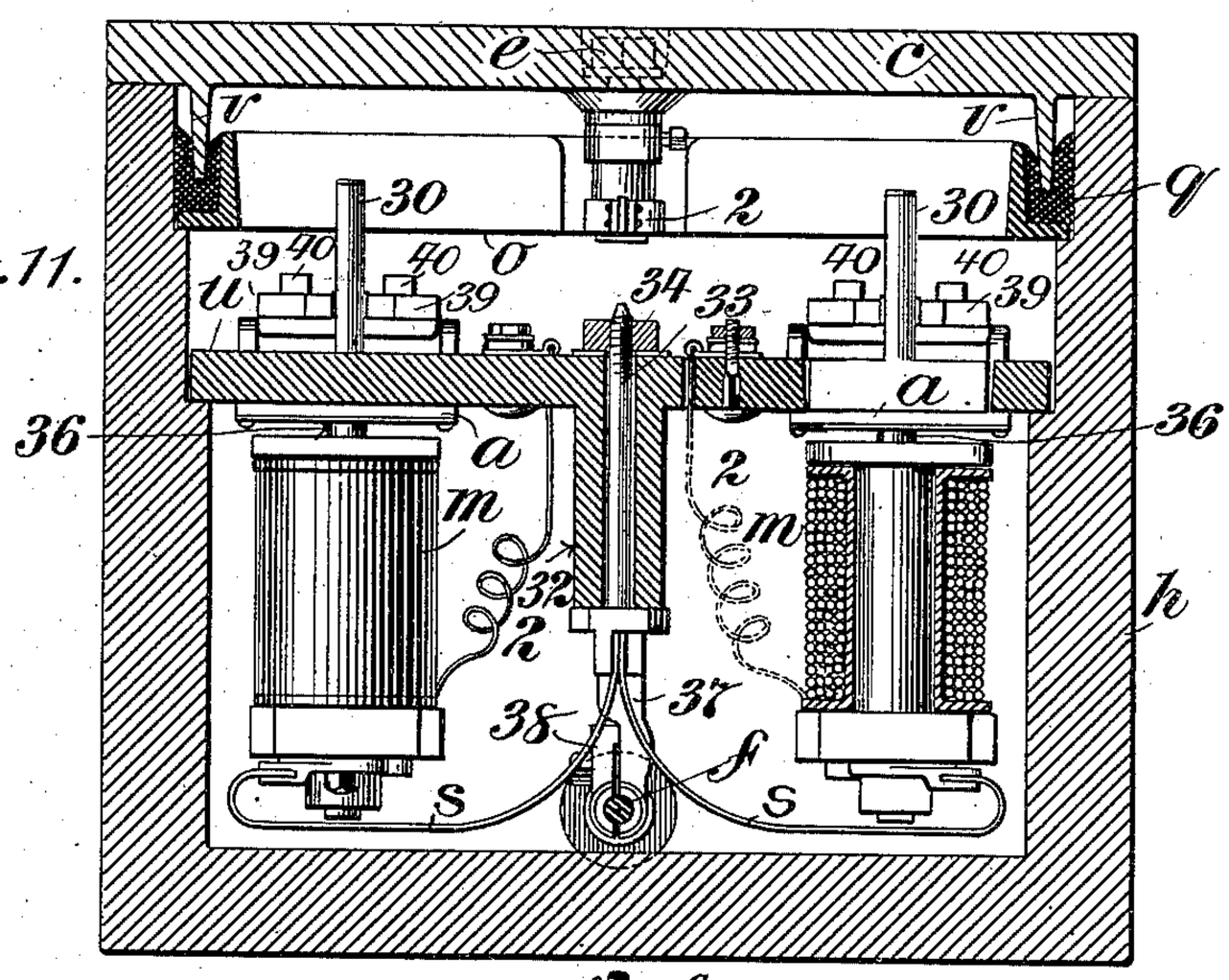
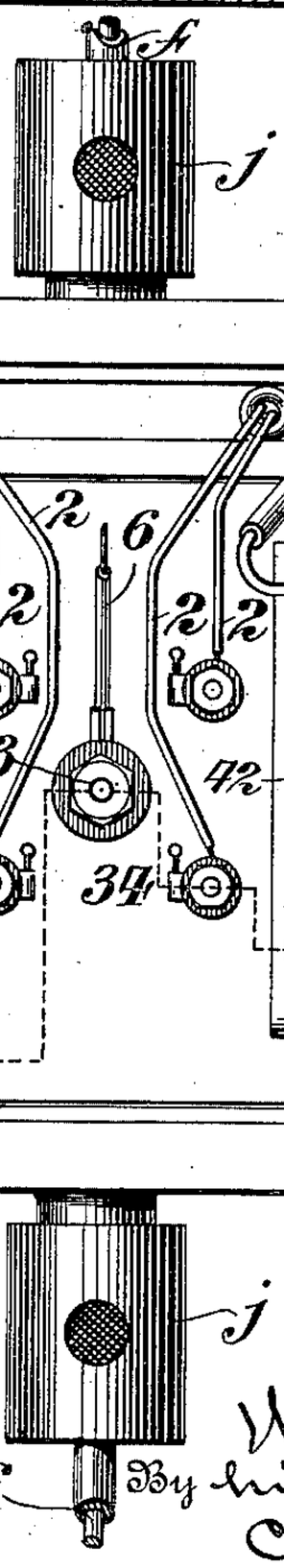


Fig. 12.



Witnesses
Edward C. Rowland.
M. F. Keating

Inventor
William Grunow Jr.
By his Attorney
Charles J. Kintner

No. 662,419. Patented Nov. 27, 1900.

W. GRUNOW, JR.

ELECTRIC RAILWAY.

(Application filed Apr. 5, 1900.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 13.

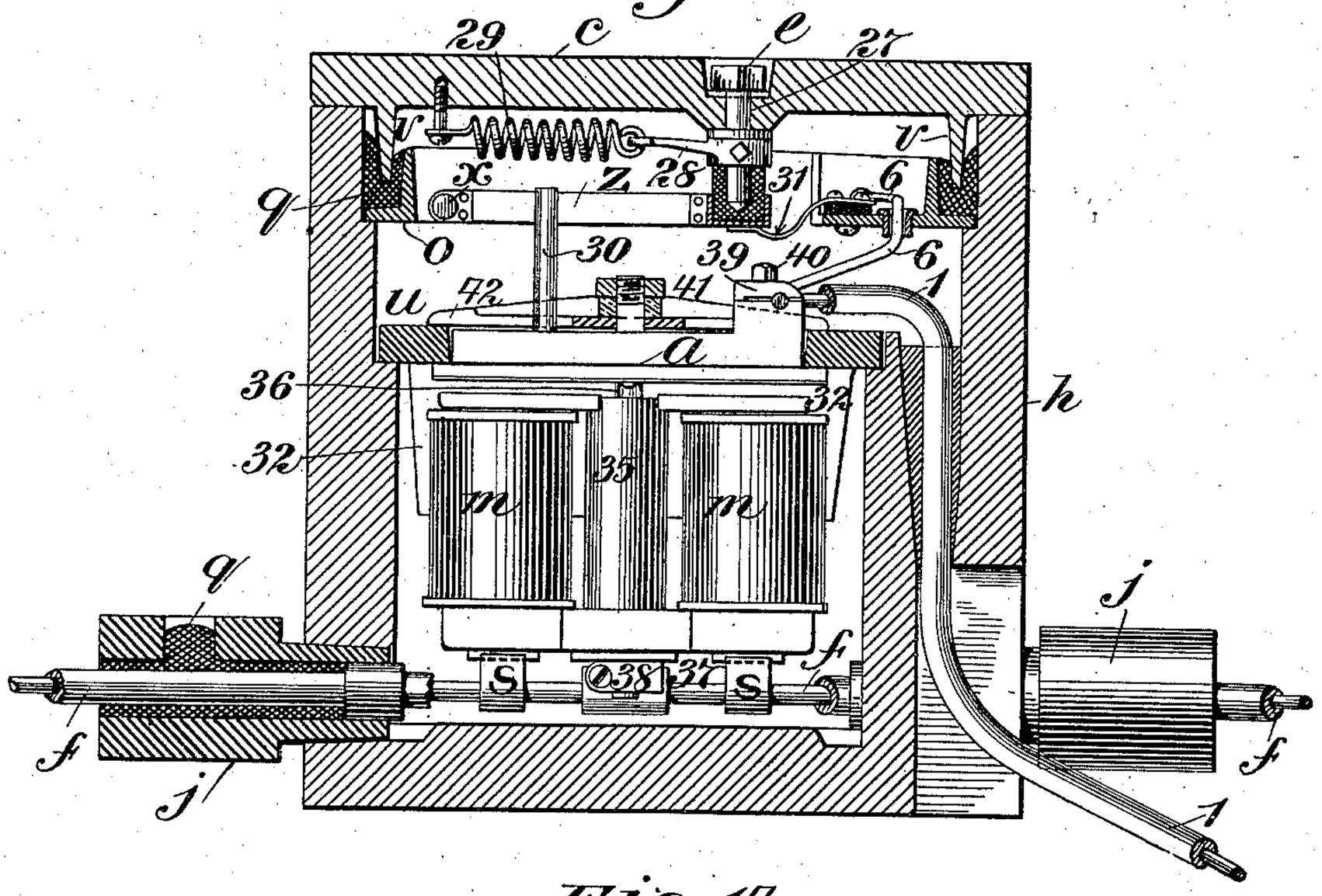
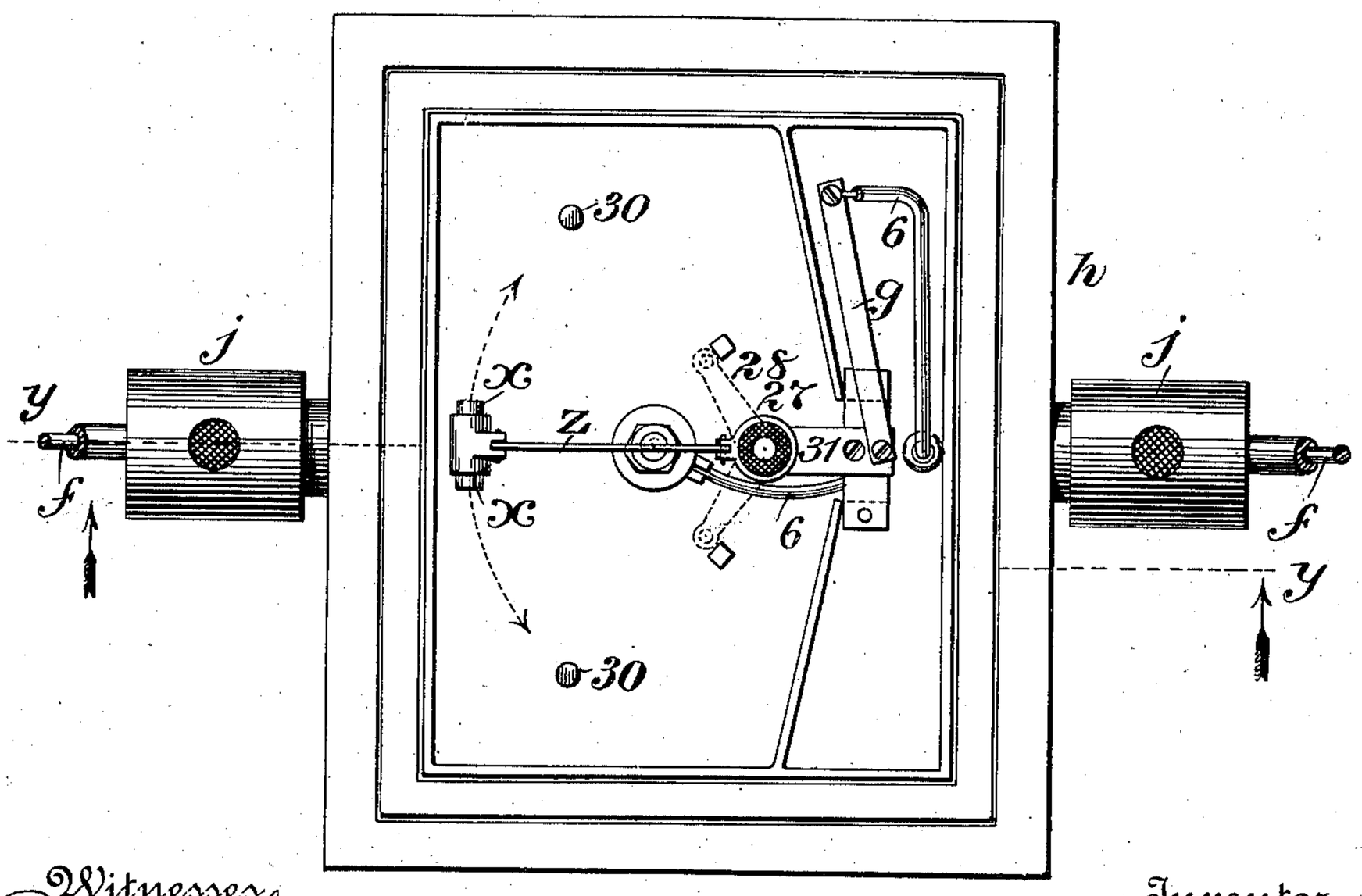


Fig. 14.



Witnesses
Edward C. Loveland.
M. F. Keating

Inventor
William Grunow Jr
By his Attorney
Charles J. Kintner

UNITED STATES PATENT OFFICE.

WILLIAM GRUNOW, JR., OF BRIDGEPORT, CONNECTICUT, ASSIGNOR TO THE McELROY-GRUNOW ELECTRIC RAILWAY SYSTEM, OF SAME PLACE.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 662,419, dated November 27, 1900.

Application filed April 5, 1900. Serial No. 11,645. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM GRUNOW, Jr., a citizen of the United States, and a resident of Bridgeport, county of Fairfield, and State of Connecticut, have made a new and useful Invention in Electric Railways, of which the following is a specification.

My invention is directed particularly to improvements in third-rail or surface contact systems of electric railways—such, for instance, as is disclosed in a prior patent, No. 631,073, granted to me on the 15th day of August, 1899—and its objects are, first, to provide a system whereby all the requirements and conditions of operation are performed by the one source of electrical supply or current generated at the power-station—that is to say, the generated current at the power-station is directly used in closing branch feeder-circuits in advance for each section; also, in reëstablishing the circuit for a section when the current is lost or again regenerated, whereby secondary or storage batteries or other independent sources of current-supply are entirely dispensed with, so that cars, such as are at present electrically wired and equipped, may be employed on this system without requiring any additional parts or apparatus in connection therewith, a sliding surface contact-shoe being required in place of the trolley-pole or conduit-plow shoe; second, to so arrange the twin or double conductors which constitute the third rail of the system disclosed in the beforementioned patent that the working circuit to the successive sectional conductors may be closed in advance as a car moves in either direction over the roadway, thereby assuring live-rail sections for supplying the working current to the motors on board the same when the conducting or trolley shoe comes in contact therewith and permitting the car to travel at greater speed; third, to so arrange the supply and energizing conductors of each section constituting the third rail of the system that the same are placed "alternately" with respect to one another in each successive section, forming two parallel continuations of alternating conductors or rails, with both of which a trolley-shoe attached to the car is caused to make simultaneous contact as it passes thereover, whereby the annoyances and disasters from "short-circuiting" between both parallel conductors are avoided by each receiving equal potential and polarity of current; fourth, to provide means at stated intervals along the roadway, preferably at each switch-box, for enabling a motorman to manually effect the transmission of the generated current to the sectional supply-conductors and the closure of the energizing-circuit from the current feeder or main to and through the switching-magnets which automatically connect said current feeder or main to the sectional supply-conductors as a car travels thereover should the current be lost or broken from any temporary cause—such, for instance, as derailment of the car or the sudden stopping of the generator at the power-house; and, fifth, to provide a simple and efficient means for securing the two-part third rails to the ties of the track in such manner that they may be quickly put in place and without undue labor or without unnecessarily disturbing the body of the road-bed.

Referring now to the drawings for a full and clear understanding of my invention, such as will enable others skilled in the art to construct and use the same, Figure 1 is a diagrammatic view illustrating my improved third-rail system and two tram-cars in the act of passing thereover, also the manner of placing the supply and energizing conductors alternately. Fig. 2 is a diagrammatic view illustrating the circuits and circuit connections of one form of my novel switch for enabling a motorman to manually effect the closure of the energizing-circuit from the current feeder or main to and through the switching-magnets which automatically connect said current feeder or main to the sectional supply-conductors should the current again flow after it had previously been cut off at the power-house or elsewhere. Fig. 3 is a diagrammatic view illustrating the circuit and circuit connections of another form of novel switch or means for enabling a motorman to electrically effect the closure of the energizing-circuit with a portable low-potential battery. Fig. 4 is a similar diagrammatic view showing a portable battery carried by the car, with means for recharging

same when desired. Fig. 5 is an enlarged transverse sectional view of the roadway, taken on the line 2 2, Fig. 1 and as seen looking thereat from left to right, the trolley-shoe, tie-rod, and one of the supporting cross-ties being shown in elevational view. Fig. 6 is a short longitudinal sectional view taken through Fig. 5 on the line *z z* and as seen looking thereat from right to left, the trolley-shoe, however, not being shown in this view. Fig. 7 is a part side elevational and part sectional view of my novel duplex trolley-shoe, and Fig. 8 is a plan view of the same as seen looking at Fig. 7 from the top toward the bottom of the drawings. Fig. 9 is a plan view of one of the duplex trolley-shoes as seen looking at Fig. 7 from the bottom toward the top of the drawings. Fig. 10 is a perspective view of one of the insulating-blocks which secure and support the sectional third-rail conductors in position in the road-bed. Fig. 11 is a sectional view taken through one of the switch-boxes on the broken line *x x*, Fig. 12; and Fig. 12 is a plan view of the same as seen looking at Fig. 11 from the top toward the bottom of the drawings, the cover thereof, however, being removed. Fig. 13 is a sectional view of one of the switch-boxes, taken on the line *y y*, Fig. 14; and Fig. 14 is a plan view thereof as seen looking at Fig. 13 from the top toward the bottom of the drawings, the cover of the box, however, being removed.

Referring now to Fig. 1 of the drawings, *t t* represent the tram-rails of a railway and *f* the current feeder or main connected to a power-house generator *d*. 3 3 3, &c., represent sectional energizing conducting-rails for supplying the energizing-current to the electromagnetic feeder-terminals at the poles of the magnets *m m m*, and 4 4 4, &c., represent sectional supply or conducting rails for supplying the working current to the motors *n* on board of the car provided with the usual tram-wheels *w w w*, *k* being a controller of the usual type for regulating the flow of current to and through said motors. It will be noticed that the sectional energizing-rails 3 3 3 are somewhat longer than are the corresponding sectional supply or conducting rails 4 4 4, that they are located relatively upon alternate sides, and that both sets of said rails when so located are substantially continuous except as to the slight insulation between their adjacent ends, the arrangement being such that as the trolley-shoes *b b* pass thereover in either direction they will always bridge the rails 3 4 and supply current to the electromagnetic feeder-terminal next in advance in such manner as to first connect the circuit to its corresponding sectional conducting-rail 4, which supplies the working current to the motors *n* on board of the car. The sectional energizing-rails 3 are connected each by a conductor 2, running to the energizing-coils around the magnet-terminals *m* and through a resistance-box *r*, the other end thereof being connected to earth through one of the tram-rails *t*, while the sectional conducting-rails 4, which supply the current to the motors, are connected directly by branch feeder-conductors 1 to stationary armatures *a*, the arrangement being such that as a car travels over the route the circuit is closed from the current feeder or main *f* through flexible band-connectors *s*, cores of the magnets *m*, branch feeder-conductor 1, trolley-shoes *b*, conductors 5 on board of the car, through the controller *k*, the motors *n*, thence through the framework of the car, the wheels *w*, and tram-rails *t*, the current returning to the generator at the power-house. A branch of the current is transmitted by the shoes from the supply-rail to the corresponding energizing-rail 3 and has therefore at this point the same potential. This branch current then passes by the conductor 2, coils of the magnet or feeder-terminal *m*, resistance-box *r* to the tram-rail *t*, and thence to the generator *d* at the power-house, the general operation being different from that disclosed in my prior patent above referred to in that in this arrangement at both of the conductors 3 and 4, forming the twin rail, there is an equal or like potential and also like polarity, so that there is no tendency to current leakage between the two.

6 is a branch feeder in each switch-box running from the current feeder or main *f* to one of the manual switches *e* for effecting the manual connection of the circuit through the motors on board of the car when the current is flowing again in the current feeder or main and after it had been previously cut off at the power-station or lost by derailment of the car or otherwise, as will be described more particularly in connection with the description of Figs. 11, 13, and 14.

Referring now to Fig. 5 of the drawings, *t t* are the tram-wheels, supported by the usual cross-ties, 9 being a tie-rod for securing the tram-rails together. 10 (illustrated also in perspective view in Fig. 10) is one of a series of blocks of insulating material—such as reconstructed granite, vitrified stone, or creosoted wood—placed at intervals upon the cross-ties or separate foundation, if preferred, and secured thereto in any preferred manner in direct alinement with each other, preferably in the center of the road-bed, said blocks being grooved, as shown, on opposite sides and partaking on their upper sides of the conformation of the under and inner surfaces of the L-shaped sectional conducting-rails 3 and 4, which, however, may be of any other desired shape. These rails when secured in position, as shown, are separated from each other by an insulating medium 12′ of any preferred material—such as vitrified stone, asphalt, or the like—such an arrangement with the supporting-blocks 10 making it feasible to lay down or place in position in the center of the road-bed of an ordinary street-railway the twin conducting-rails with a minimum amount of labor and without unnecessarily

disturbing the road-bed surface. 11 11 are insulating-wedges of creosoted wood or similar material driven between the lower surfaces of the rails 3 4 and the tie-rods 9, so as to prevent any possibility of current leakage or contact. After the rails 3 4 are thus secured in position the road-bed is properly prepared in the usual manner, so that the upper surfaces of the rails are located at a very slight elevation above the same, so as to at all times support the trolley-shoe *b* without any danger of interruption of the circuit.

In Figs. 7, 8, and 9 is illustrated my novel form of duplex trolley-shoe, the same consisting, preferably, of a two-part wooden supporting-frame 12, secured together at its opposite ends by angle-irons 13 and bolts 14 14 14 14 15 15 15 15, said angle-irons being provided with bolt-holes for securing the entire structure in any preferred manner beneath the body of the tram-car. 16 16 are rectangular metallic sleeves secured between the two-part frame 12 and adapted to act as vertical guides for movable metallic standards 17 17, to the lower ends of which are pivotally attached by iron pins 21 duplex sliding trolley-shoes *b b*, said trolley-shoes having upwardly-extending ears or lugs through which the aforesaid pins are inserted and held in place by keys 23, the arrangement being such that the trolley-shoes have lateral pivotal movement around their supporting pivot-pins 21. Extending through the upper end of each of the standards 17, at right angles to the pivot-pins 21, is a pin 24, adapted to support the forked end of a yoke 8, in the center of which is secured a pin 25, and to which in turn is attached a strong spiral spring 19, extending downwardly between the two-part frame to a cross-pin 22, secured on the under side of the frame, and all so constructed that the two standards 17 are adapted to partake of yielding vertical movement in either direction, according as the trolley-shoes *b b* are lifted or lowered individually, such an arrangement being especially adapted to pass over the crossings of other tracks and uneven surfaces should the same prevail and always assure absolute continuance of metallic contact with the sectional rails, the front shoe performing also the additional function of clearing away any dirt or other matter which might offer unnecessary obstruction or resistance to the operating-current. No claim is made in the present application, however, to this especial form of double or duplex trolley-shoe, as the same constitutes the subject-matter of a divisional application filed by me in the United States Patent Office on the 21st day of May, bearing Serial No. 17,471.

Referring now to Figs. 11 to 14, inclusive, I will describe the interior structure of the switch-boxes, which may be located either in the road-bed or preferably at the side thereof, especially where the system is one embodying double tracks. These switch-boxes *h* are made preferably of such material as will render them impervious to moisture and at the same time give to them the greatest durability and strength and are provided at their lower sides with inlet-openings diametrically opposite each other for admitting the insulated feeder *f*, said openings being sufficiently large to admit of the insertion of two-part creosoted or other insulating-plugs *j*. After the plugs are inserted the insulation is further effected by pouring through an opening in the upper side thereof an insulating medium *q*. *c* represents the cover of the box, which is made, preferably, of strong cast-iron and is provided on its underside with a flange *v*, adapted to extend downwardly a definite distance, so as to enter a groove around the outer surface of a cast-metal frame *o*, which is supported upon an internal ledge near the top of the box, the groove being filled, as shown, when the apparatus is ready for use with a sealing medium *q*, like that used in connection with the sealing-plugs *j* at the bottom of the box. *u* is a removable supporting-frame for the switching mechanism made of some insulating material and sustained by a second ledge in the interior of the box, said frame having near its center an oblong downwardly-extending part 32, as illustrated in Figs. 11 and 13, through which is bored a hole adapted to receive a metallic bolt 33, provided with a head at its lower end and screw-threaded at its upper end for the purpose of receiving a retaining-nut 34, the head of said bolt having a clamping extension corresponding with a like part 37, adapted to firmly secure when bolted together the inner ends of two pairs of flexible conducting-bands of copper *ss ss*, the other ends of which are metallically connected to the yokes of the respective pairs of switching-magnets *mm mm*. The lower end of the metallic part 37 is secured by a screw-bolt and clamping part 38 directly in electrical connection with the cable or feeder *f*. In this way the magnet-cores form the terminals of the feeder within the box. *a a* are fixed or stationary armatures secured in oblong openings in the supporting-frame *u* by rectangular-shaped metallic cleats 42 42 and nuts 41 41, the arrangement being such that the outer lower ends of the armatures and the outer ends of the rectangular-shaped metallic cleats 42 42 clamp or securely hold the parts to said frame. These armatures *a a* are preferably plated on their under surfaces with copper, as shown in Figs. 11 and 13 of the drawings, for the purpose of preventing adherence between them and the pole-pieces of the magnets. 35 35 are insulating-sleeves, preferably of hard rubber, seated in openings in the yokes of the magnets *m m* and between the upper pole-pieces thereof, said sleeves being designed to act as guides in the up and down movements of the magnets about downwardly-extending brass guide-rods 36 36, secured to the stationary armatures *a a*. These

brass guide-rods are threaded at their lower ends and furnished with nuts, so as to adjust the air-gap or the amount of "rise and fall" between the contacting surfaces of magnet and armature. The coils of the magnets are connected to the incoming branch conductors 2 2 by bolts secured in the supporting-frame *u*, and the conductors are led thence outside the box and connected to the tram-rail *t* and sectional energizing conducting-rails 3. Resistance-boxes *r r*, each of such resistance as will permit the flow of requisite current to effectually operate the switch-magnets *m m*, are connected in series with the coils thereof in shunted circuit, as shown in Figs. 1, 2, 3, and 4, the object of the resistances being to reduce the current to a minimum amount. The branch feeders 1 and conductors 2 are admitted to the inside of the boxes, as shown in Figs. 12 and 13, and securely insulated therefrom, the inner ends of the feeders 1 being attached directly to the stationary armatures *a* by binding-clamps 39 39 and nuts 40.

The branch conductor 6, referred to above in connection with Figs. 1, 2, and 3, is illustrated in Figs. 12 and 13, and is shown therein with its lower end connected directly to the bolt 33, which is connected, as above described, directly to the current-feeder *f*, its upper end extending upwardly through an insulating-thimble in the frame *o*, where it is connected directly to an automatic cut-out device or fuse *g*, the other end of which is connected to a yielding metallic strip 31, the free end of which bears upwardly against a metallic cup which constitutes the inner end of a metal switching-arm *z*, insulated from and pivotally secured to the under surface of the box-cover by a pivot-rod 27, the outer or free end of which is provided, preferably, with a five-sided nut located outside of the box and accessible to a motorman for the purpose of operating it with a corresponding wrench. 28 is an arm secured to the same pivot-rod 27, the free end of said arm being connected to a strong spiral spring 29, the other end of which is in turn secured to the under surface of the cover, the arrangement being such that under normal conditions the arm *z* stands out of contact in the position shown in Fig. 14, *x x* being carbon contact-points adapted to contact when the switch is moved in either direction, with metallic pins 30 30, secured firmly to the armatures *a a* and to automatically disconnect therefrom when released. The fuse or cut-out *g* is located within a groove made by inwardly-extending ledges and one side of the frame *o*, as clearly shown in Figs. 13 and 14.

It will be apparent on inspection of Figs. 11, 13, and 14 that the manual switch for effecting circuit connection through the coils to either of the pairs of switching magnets may be effected by rotating the arm *z* either to the right or left, as indicated by the curved arrows in Fig. 14, and that when this is done the corresponding pair of magnets will be energized and lifted when the feeder-circuit is closed by the trolley-shoes *b b*. At that time the current will continue to flow therethrough and the motorman may release the manual switch, in which event it will turn to its normal position out of contact under the influence of the spring 29.

In Fig. 4 of the drawings I have illustrated a modified form of the manual switching apparatus, in which *b a* represents a portable battery adapted to be carried by the car, and 6 a flexible conductor which may be extended to any length, the arrangement being such that the battery may be carried by the motorman to a point near the switch-box and the opposite poles connected, respectively, at the insulated pin *p* and the nearest one of the two tram-rails *t*, in which event the magnet-energizing circuit will be closed through the tram-rail *t*, the conductor 2, coils of the magnet, the fuse *g*, conductor 6 to starting-point, thereby temporarily energizing the magnet and causing the armature *a* to be lifted and the circuit to be connected through the cores of the magnets, the branch conductors 1, and the sectional rails 3 4, and shoe *b*, as before. *s w* represents a switch which may be operatively connected with the working circuit and the battery for recharging it when necessary.

In the modified form shown in Fig. 3 the magnet is connected by flexible copper bands *s* in the same manner as the corresponding magnets are illustrated in connection with the other figures of the drawings.

No claim is herein made to the application of the broad principle of a manual switch located near the road-bed of an electric railway and so arranged and interconnected with the sectional rails or conductors in a system of the type referred to that a motorman may reëstablish the circuit between the station-generator and the sectional rails or conductors under a car after the same has been disrupted nor to the specific types of such switch mechanism disclosed in Figs. 2, 3, and 4 of the drawings and hereinbefore described, as these features constitute the subject-matter of two separate or individual applications, filed of even date herewith and bearing Serial Nos. 11,646 and 11,647.

The broadest features involved in the present application relate to the alternately-placed supply and energizing conductors of each successive section of twin third rail, both conductors of a section having a like or equal potential and polarity when charged, and the combination with the same of a trolley-shoe simultaneously bridging both conductors, the shunted energizing-circuit with buried resistance in series with same, and the combination of a manually-operative switch.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a surface-contact system of electric

railways a series of alternately-placed supply and energizing conductors constituting successive sections of a twin-rail system, substantially as described.

2. In a surface-contact system of electric railways alternately-placed supply and energizing conductors constituting successive sections of a twin-rail system and circuit connections between the current-feeder and said conductors whereby the current potential and polarity are the same at each when charged, substantially as described.

3. In a surface-contact system of electric railways a series of alternately-placed supply and energizing conductors constituting successive sections of a twin-rail system; electromagnetic switching devices; circuits and circuit connections including resistances for maintaining the potential and polarity of the current alike for any pair of such conductors, substantially as described.

4. In a surface-contact system of electric railways, a current feeder or main, a series of alternately-placed supply and energizing conducting-rails, the energizing-rails being of greater length than the supply-rails; electromagnetic switching-magnets electrically connected to the energizing-rails and each included in circuit with a resistance; in combination with a trolley-shoe adapted to bridge the space between the energizing and conducting rails as it passes thereover, the arrangement being such that the potential and polarity of the current is always alike at the rails as they are connected to the feeder or main, substantially as described.

5. In a surface-contact system of electric railways two substantially continuous sets of sectional rails or conductors arranged side by side, one set being connected to the coils of the switch-operating magnets and the other to the switches for conveying the working current to the motors on board the cars, the first set being so located with relation to the second that the sectional conductors which convey the working current to the motors on the cars are made alive before the conducting trolley or shoe reaches them, substantially as described.

6. In a surface-contact system of electric railways two sets of sectional rails or conductors arranged in parallel rows, one set being connected directly to the coils of the switch-operating magnets and the other to the switches for conveying the working current to the motors on board the cars; each rail or conductor of the first set being longer than its fellow rail or conductor of the second set; together with a trolley or shoe and circuit connections whereby each rail or conductor which conveys current to the motor on board a car is made alive before the trolley or shoe reaches it and without relation to the direction in which the car may be traveling, substantially as described.

7. In a surface-contact system of electric railways two parallel sets of sectional rails or conductors which are substantially continuous, each individual rail of one set being longer than its fellow of the other set; in combination with circuit connections to the switch-controlling magnets and switches whereby the working current is connected to the sectional rails or conductors which convey it to the motors on board the cars before the trolley or shoe makes contact therewith, no matter in which direction the car be running, substantially as described.

8. In a surface-contact system of electric railways two sets of sectional rails or conductors which are substantially continuous and individually of unequal lengths, and circuit connections between the coils of the switching electromagnets, the switches, and the sectional conductors; together with a trolley or contact-shoe adapted to bridge both sets of sectional rails or conductors, the arrangement being such that the potential at each of the parallel sectional conductors is always the same, substantially as described.

9. In a surface-contact system of electric railways a source of electrical energy included in circuit with a current feeder or main located beside the road-bed; normally open branch feeder-circuits connected to sectional rails or conductors located in the road-bed; switching-electromagnets and circuit connections therethrough for automatically connecting the branch feeders to the sectional rails or conductors; in combination with manual switching devices, one for each switching-magnet, having circuit connections for restoring the circuit through either of two adjacent sectional rails or conductors as desired, substantially as described.

10. In a surface-contact system of electric railways a current feeder or main, sectional service rails or conductors for supplying current to the motors; electromagnetic switching devices for automatically connecting the current feeder or main to the sectional rails or conductors; in combination with a manual switch for each electromagnetic switching device and circuit connections whereby the circuit may be restored to either of two adjacent sectional rails or conductors as desired, said manual switching device being secured in the box which surrounds or protects the electromagnetic switching devices and circuit connections, substantially as described.

11. In a surface-contact system of electric railways means for securing a two-part third rail in the road-bed, consisting of insulating-blocks grooved in their upper surface and adapted to sustain the two parts of the rail within the groove; together with a rigid insulating medium filling the space in the grooves between the sustained rails, substantially as described.

12. In a surface-contact system of electric railways a series of sectional rails or conductors arranged in pairs side by side and sustained by blocks of insulating material, said rails being held in place by the walls of the

blocks and a rigid insulating medium put in place after the rails are laid in position, substantially as described.

13. In a surface-contact system of electric railways a series of grooved sustaining-blocks adapted to rest upon the roadway; in combination with L-shaped sectional rails or conductors adapted to be sustained by the lateral walls of the grooved blocks, together with an insulating medium filling the space between the inner faces of the rails, substantially as described.

14. In a surface-contact system of electric railways a pair of tram-rails supported by cross-ties and united together at intervals by tie-rods; a series of grooved blocks of insulating material sustained by the ties in alinement with each other; a series of L-shaped sectional rails or conductors sustained by said blocks and held against the inner walls thereof by a rigid insulating medium; together with insulating blocks or wedges between the sectional rails and the tie-rods, substantially as described.

15. In a system of electric railways a watertight switch-box provided with a removable supporting-frame beneath which is secured the switch-controlling electromagnets, the same being adapted to move vertically under the influence of magnetism and gravity; together with armatures rigidly secured by said frame over the poles of the magnets, substantially as described.

16. In a system of electric railways a watertight switch-box provided with a removable supporting-frame beneath which is secured one or more pairs of switch-controlling electromagnets; together with armatures rigidly held in the frame, and guiding means for permitting the magnets to move vertically under the influence of magnetism and gravity, substantially as described.

17. In a system of electric railways a watertight switch-box provided with a metallic cover; in combination with an electromagnetic switching device located in said box, together with a manual switch pivotally secured in the cover of the box, and circuit connections between said switch, the electromagnets and the sectional rails or conductors of the system, whereby the current may be reëstablished, at will, from the current-main through the operating electromagnet or magnets, by a motorman, substantially as described.

In testimony whereof I have hereunto subscribed my name this 4th day of April, 1900.

WILLIAM GRUNOW, JR.

Witnesses:
C. J. KINTNER,
M. F. KEATING.