No. 607,351. Patented July 12, 1898.

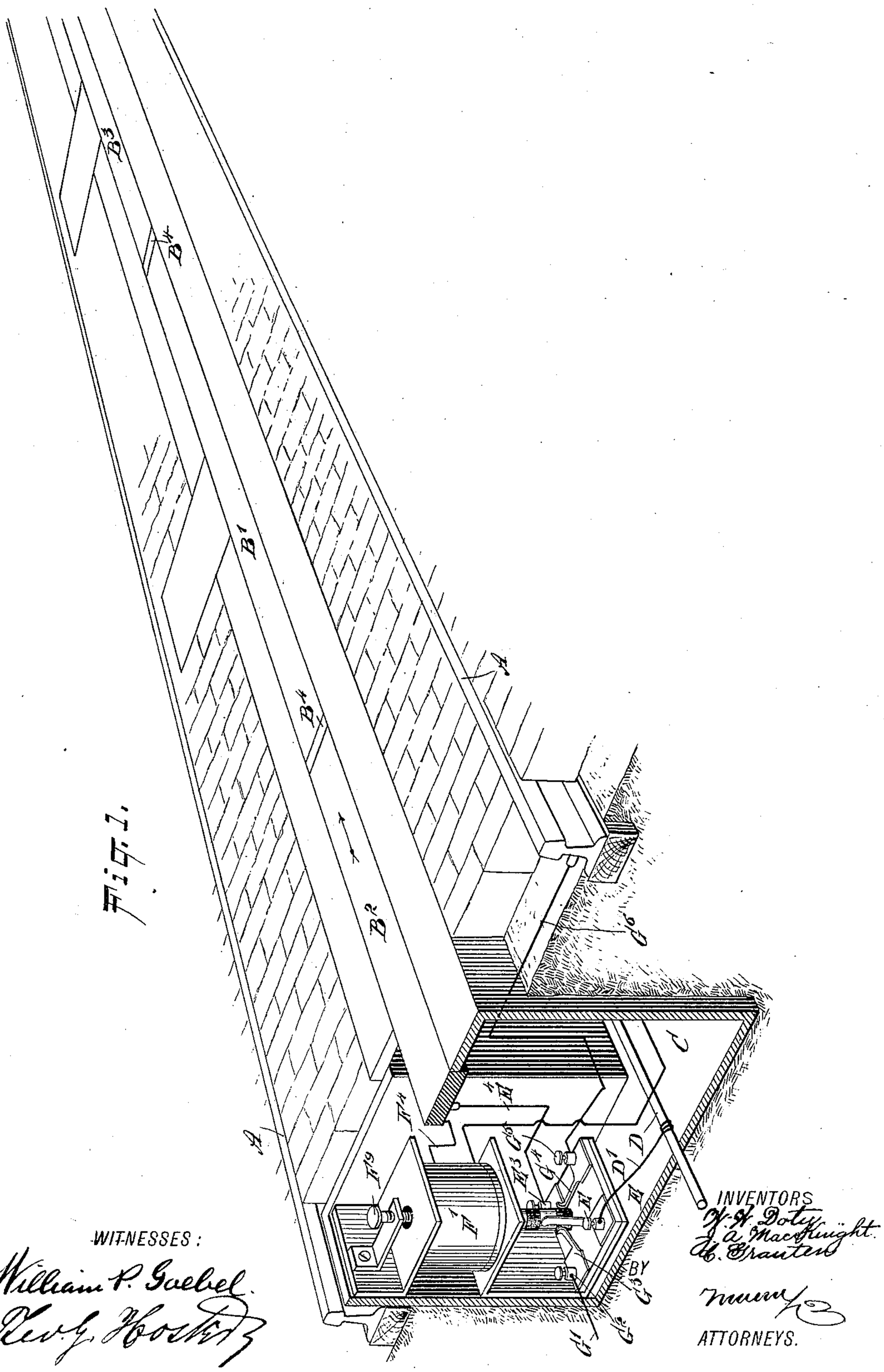
W. W. DOTY, J. A. MacKNIGHT & C. GRAUTEN.

ELECTRIC RAILWAY.

(Application filed Jan. 25, 1897. Renewed Dec. 24, 1897.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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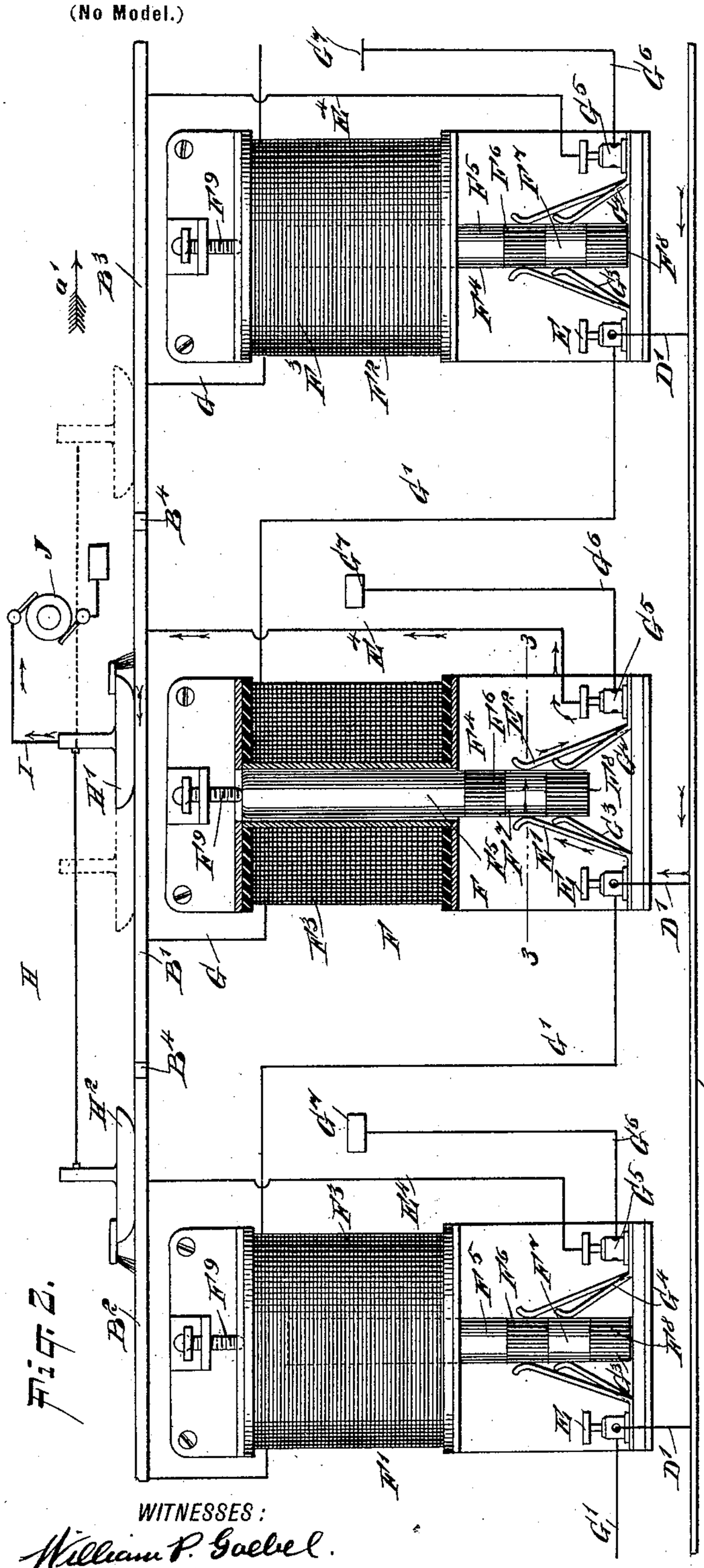

Fig. 2.

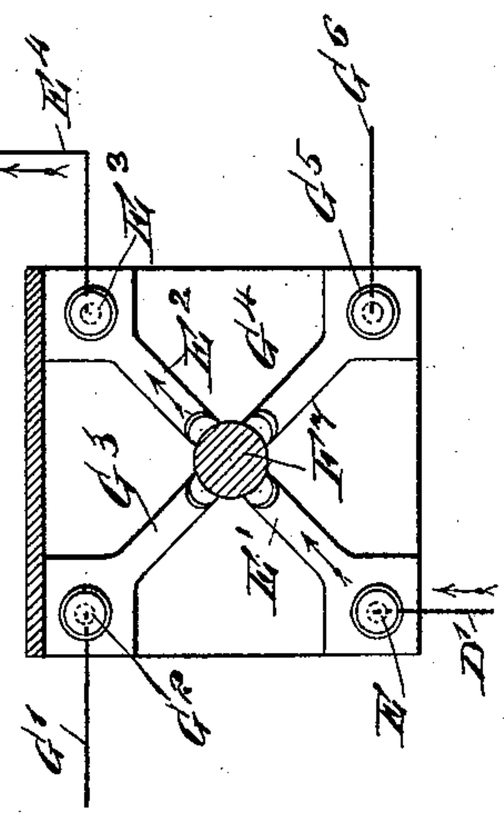

Fig. 3.

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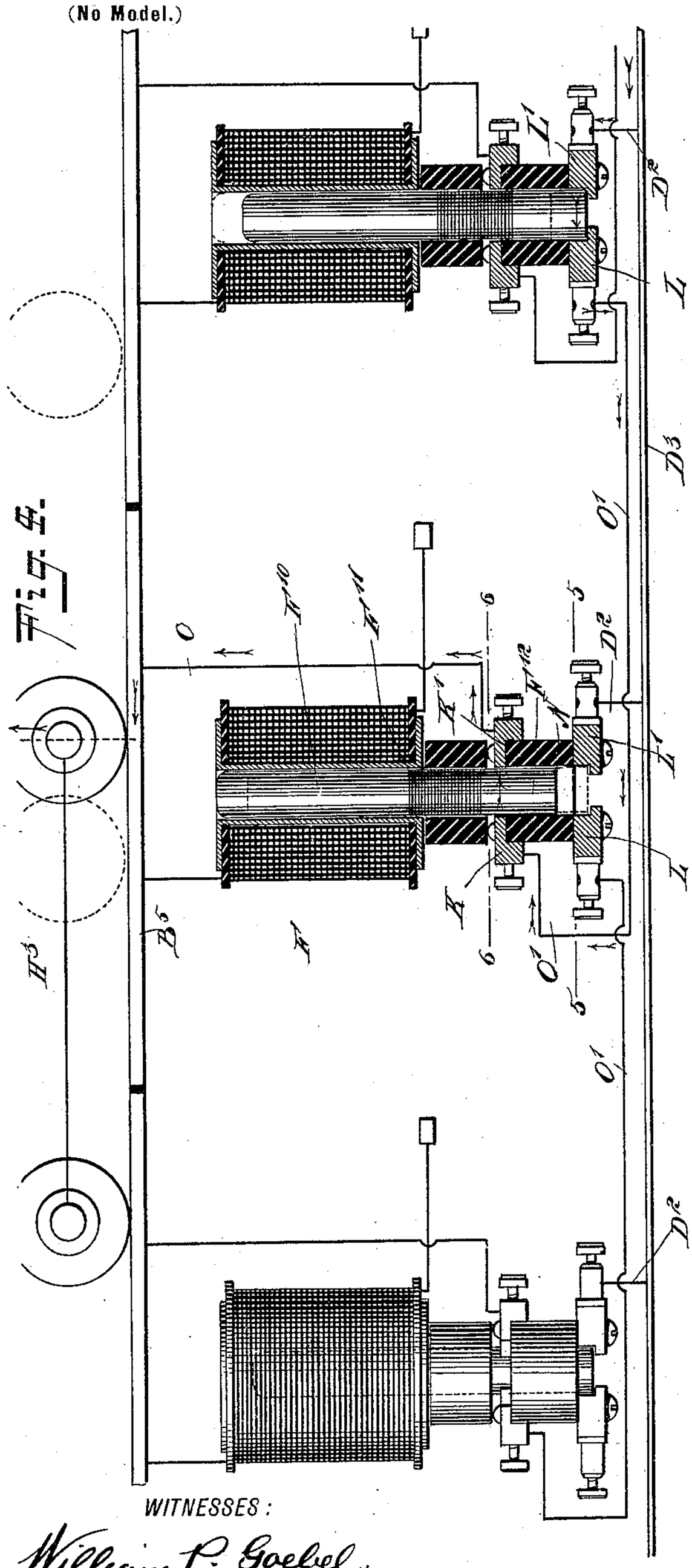

FIG. 4.

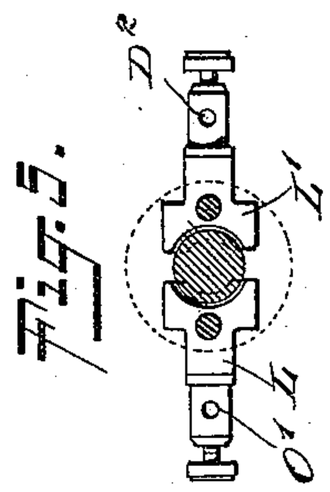

FIG. 5.

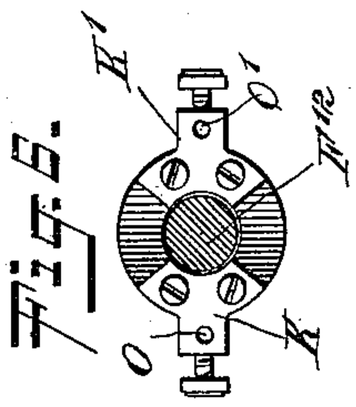

FIG. 6.

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UNITED STATES PATENT OFFICE.

WILLIAM W. DOTY, OF NEW YORK, JAMES A. MACKNIGHT, OF MOUNT VERNON, AND CHARLES GRAUTEN, OF NEW YORK, N. Y., ASSIGNORS, BY MESNE ASSIGNMENTS, TO W. W. DOTY & CO. AND WILLIAM REINHART, OF NEW YORK, N. Y.

ELECTRIC RAILWAY.

SPECIFICATION forming part of Letters Patent No. 607,351, dated July 12, 1898.

Application filed January 25, 1897. Renewed December 24, 1897. Serial No. 663,400. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM W. DOTY, of the city and county of New York, JAMES A. MACKNIGHT, of Mount Vernon, county of Westchester, and CHARLES GRAUTEN, of the city and county of New York, State of New York, have invented a new and Improved Electric Railway, of which the following is a full, clear, and exact description.

The invention relates to electric railways having an underground feed-wire connected with the power-house or other source of electricity.

The object of the invention is to provide a new and improved electric railway designed for propelling cars and trains over long or short distances and arranged to maintain a steady current for running the cars properly without danger from deadly overhead or rail currents.

The invention consists of certain parts and details and combinations of the same, as will be fully described hereinafter and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional perspective view of the improvement. Fig. 2 is an enlarged sectional side elevation of the same. Fig. 3 is a sectional plan view of part of the improvement on the line 3 3 of Fig. 2. Fig. 4 is an enlarged sectional side elevation of a modified form of the improvement. Fig. 5 is a sectional plan view of part of the same on the line 5 5 of Fig. 4, and Fig. 6 is a similar view of part of the same on the line 6 6 of Fig. 4.

The improved electric railway is provided with the usual track-rails A, on which travel the wheels of the car to be propelled over the road. Between the rails A is arranged in the road-bed a working conductor B, made in sections B' B^2 B^3, insulated one from the other by a suitable insulating material B^4, as plainly indicated in Figs. 1 and 2. In the road-bed is arranged a conduit C, through which extends a feed-wire D, connected with a suitable source of electricity-supply and connected by the branch wires D' and binding-post E with circuit-controllers F, F', and F^2, one for each rail-section B' B^2 B^3, respectively, as plainly indicated in Fig. 2.

The circuit-controllers are preferably made in the form of solenoids, each having the coil of wire F^3 and a plunger F^4 made in sections F^5, F^6, F^7, and F^8, of which the section F^5 extends in the center of the coil of wire F^3 and is made of a magnetic material, while the section F^6 projects below the coil of wire and is made of a non-conducting and non-magnetic material, such as lava, while the next section F^7 is made of carbon or a like conducting material, and the lowermost section F^8 is similar to the section F^6, preferably made of lava. The coil of wire F^3 of each solenoid is connected by a wire G with the corresponding working-conductor section of the solenoid and by a wire G' with a binding-post G^2 of the next following solenoid. The binding-post G^2 of each solenoid is connected by a contact-plate G^3 with the lower end of the plunger F^4 of this solenoid, and a similar contact-plate G^4 engages this solenoid-plunger directly opposite the plate G^3, as plainly indicated in Figs. 2 and 3. The contact-plate G^4 is connected with a binding-post G^5, from which leads a wire G^6 to the ground G^7, and preferably by the way of rail A, as indicated in Fig. 1. The binding-post E previously mentioned is connected by a contact-plate E' with the lower end of the plunger F^4, and a similar contact-plate E^2 engages the plunger diametrically opposite the plunger E', as shown in Figs. 2 and 3. By reference to said figures it will be seen that the sets of contact-plates G^3 G^4 and E' and E^2 stand at right angles to each other and with the contact-plates G^3 G^4 engaging the plunger F^4 at a lower level than the contact-plates E' and E^2, so that when the plunger is in a lowermost position the contact-plates E' and E^2 are electrically disconnected from each other, while the contact-plates G^3 G^4 are electrically connected with each other by way of the carbon section F^7. When the plunger of the solenoid is in an uppermost position, the contact-

plates G^3 and G^4 are electrically disconnected from each other, while the contact-plates E' and E^2 are electrically connected with each other by the carbon section F^7. The contact-plate E^2 connects with a binding-post E^3, from which leads a wire E^4, connecting with the working-conductor section of the particular circuit-controller F, F', or F^2.

Now it is evident that when the coil or wire F^3 of a solenoid is energized then the plunger F^4 is drawn into an uppermost position, as shown by the circuit-controller F in Fig. 2, and when the plunger F^4 is in this position then the contact-plates E' E^2 are in engagement with the carbon section F^7 of the said plunger F^4, and consequently electricity can pass from the feed-wire D through the branch wire D' to the binding-post E and from the latter by the contact-plates E' E^2 and carbon section F^7 to the binding-post E^3 and by the wire E^4 to the corresponding working-conductor section—for instance, as shown in Fig. 2, to the section B'. When the plunger F^4 is in this uppermost position, the contact-plates G^3 and G^4 are in engagement with the lower non-conducting section F^8, and consequently the wires G' G^6 are disconnected from each other—that is, the coil of wire of the preceding solenoid has no ground connection and becomes deënergized. As soon as this takes place the plunger F^4 in this preceding solenoid drops back to the normal lowermost position. When the plunger is in this position, the contact-plates E' and E^2 rest on the insulated section F^6, and consequently the electric connection between the feed-wire D and the wire E^4 is interrupted, while electric connection is made by the section F^7 with the contact-plates G^3 G^4 to allow a current to pass through the coil of wire F^3 of the preceding solenoid.

The car traveling over the rails A is provided with a double trolley H, having the trolley parts H' and H^2 in the shape of shoes, brushes, wheels, or the like, and in contact with the sectional working conductor B. The trolley parts H' and H^2 are placed one in front of the other, so as to engage adjacent sections of the transmission-rail, as plainly indicated in Fig. 2. The double trolley is also connected by a wire I with the motor J of the car, having the usual ground connection by the way of the rails.

The operation is as follows: When the several parts are in the position as illustrated in Fig. 2, then the trolley part H' is in engagement with the working-conductor section B' and the trolley part H^2 is in engagement with the conductor-section B^2. The solenoid F has its plunger F^4 in an uppermost position, so that the current from the feed-wire D can pass to the conductor-section B', as previously explained, through trolley part H' and wire I to the motor J to actuate the same so as to propel the car forward over the road. As the plunger F^4 of the solenoid F is in an uppermost position, the ground connection for the wire G' of the coil of wire F^3 of the preceding solenoid F' is cut out, so that the plunger F^4 of the solenoid is in its lowermost position. Now when the car proceeds in the direction of the arrow a' and the forward trolley part H' passes upon the following section B^3 and the trolley part H^2 is still on the section B' then a portion of the current passes to the conductor-section B^3 and by the wire G to the coil of wire F^3 of the solenoid F^2, so as to energize the same and cause an upward sliding of its plunger F^4. The moment this is done the contact-plates G^3 G^4 of the solenoid F^2 interrupt the ground connection with the wire G' of the coil of wire F^3 of the previous solenoid F, so that the latter becomes demagnetized and its plunger F^4 drops to a lowermost position, thereby cutting off the supply of electricity from the feed-wire D. The plunger F^4 of the solenoid F^2 in moving into an uppermost position makes connection between the feed-wire D and the conductor-section B^3 by the contact-plates E^8 and E^2 engaging the carbon section F^7 of the plunger.

Thus it will be seen that by the arrangement described the double-trolley wire while receiving the electricity through one conductor-section sends part of its current to the next forward conductor-section and the solenoid thereof, so as to energize the same and to break the ground connection for the previous or preceding solenoid, so that the latter becomes deënergized and breaks the current from the feed-wire to its conductor-section. At the same time electricity from the feed-wire passes to the next conductor-section to the motor of the car to propel the latter forward over the road.

It is evident that by the arrangement described only that section of the working conductor which is directly under the car is included in the circuit, while all the other conductor-sections are cut off from the source of electricity, and consequently are not dangerous for persons or vehicles crossing the track.

In the modified form shown in Figs. 4, 5, and 6 we form the plunger of each solenoid with a magnetic section F^{10} and insulated section F^{11} and a carbon section F^{12}. The plunger is adapted to pass through two sets of contact-plates K K' and L L', located one above the other and separated by insulated material N, as indicated in Fig. 4. The plate K' is connected by a wire O with the working-conductor section B^5, and the plate K is connected by a wire O' with the plate L of the next following solenoid, each plate L' being connected by a branch wire D^2 with the feed-wire D^3. Now as long as the solenoid is deenergized, as shown in the last solenoid in Fig. 4, then the section F^{12} by resting on the plates L L' connects the same with each other to cause the current to pass from the feed-wire D^3 by way of the branch wire D^2 to the plate L', section F^{12}, plate L, wire O', to plate K of the next preceding solenoid, the plunger of which is now in an uppermost po-

sition, so that the plate K is connected with the plate K′ by the section F^{12} of the solenoid to allow the electricity to pass by the wire O to the conductor-section B^5 and to the double trolley. Thus by the arrangement described the electricity is sent from a solenoid ahead of the car to and through the solenoid belonging to the conductor-section B^5 over which the car is at the time. Otherwise the operation is the same as previously described in relation to Figs. 1, 2, and 3.

By the arrangement described a steady current is sent to the motor of the car, as one of the double-trolley parts is connected with the source of electricity before the other is cut out. Furthermore, a conductor-section cannot be charged with electricity except as required by each car in passing over the section. Each solenoid or circuit-controller forms a circuit breaker and closer for the energizing-current of the preceding solenoid, a current breaker and closer for the conductor-section, as well as a feeder for its own coil, to keep the latter energized, so as to hold the plunger of this circuit-controller in an uppermost position during the time the car is over the corresponding conductor-section.

It is evident from the foregoing that the sections F^6 F^7 F^8 may be on the upper end of the plunger and the contact-plates above the solenoid-coil, instead of below, as shown and described.

It will be understood that each circuit-controller consists of three main parts—viz., the plunger forming a switch, the coil forming an electric operating device for the said switch, and the two circuit-closers operated by the switch. It will be further understood that each circuit-controller by its circuit-closers controls two circuits, which are as follows: first circuit, closed when the electric operating device of the controller is energized, from feed-wire to one of the circuit-closers of the controller, (either directly, as in Fig. 2, or through the second circuit-closer and the switch of the next controller, as in Fig. 4,) through switch of controller to working-conductor section corresponding to the same controller; second circuit, closed when the electric operating device of the controller is deenergized (normal condition) in Fig. 2, from a section of the working conductor to the electric operating device of the controller belonging to that section, to circuit-closer and switch of next controller, and thence to the ground or its equivalent; second circuit in Fig. 4, from the feed-wire to one circuit-closer of the controller, through the switch, to the other circuit-closer of the next controller, and when the electric actuating device of said controller is energized through the switch thereof and to the working-conductor section belonging to said next controller. In each case the electric actuating device of each controller is connected to the corresponding working-conductor section, and one circuit-closer controls the connection of the feed-wire with the working-conductor section belonging to the same controller, while the other circuit-closer controls the connection of the feed-wire with the working-conductor section belonging to the next controller. In Fig. 2 the electric operating device of each circuit-controller is controlled by the switch of the next controller. In Fig. 4 the electric operating device has no direct connection with the switch of any controller, but depends for its actuation solely upon the passage of the trolley or other contact device of the car over the working-conductor section connected to such electric operating device.

Having thus fully described our invention, we claim as new and desire to secure by Letters Patent—

1. The combination of the feed-wire, the sectional working conductor, and a series of circuit-controllers, one for each section of the working conductor, each of said circuit-controllers comprising a switch made with a conducting and a non-conducting section, an electric actuating device electrically connected to the working-conductor section belonging to that controller, and two circuit-closers controlled by the switch, and so arranged that only one of them can engage the non-conducting portion of the switch at a time, one circuit-closer operating, when the electric actuating device is energized, to connect the feed-wire with the working-conductor section belonging to the same controller, and the other circuit-closer operating, when the electric actuating device is deënergized, to connect the feed-wire with the working-conductor section belonging to the next controller, substantially as described.

2. The combination of the feed-wire, the sectional working conductor, and a series of circuit-controllers, one for each section of the working conductor, each of said circuit-controllers comprising a switch made with a conducting and a non-conducting section, an electric actuating device electrically connected to the working-conductor section belonging to that controller, two circuit-closers controlled by the switch and so arranged that only one of them can engage the non-conducting portion of the switch at a time, connections from the members of one circuit-closer leading respectively to the feed-wire and to the working-conductor section belonging to the same controller, and connections from the members of the other circuit-closer leading respectively to the feed-wire and to the working-conductor section to which the next controller belongs, substantially as described.

3. The combination of the feed-wire, the sectional working conductor, and a series of circuit-controllers, one for each section of the working conductor, each of said circuit-controllers comprising a switch made with a conducting and a non-conducting section, an electric actuating device electrically connected to the working-conductor section belonging to that controller, two circuit-closers con-

trolled by the switch and so arranged that only one of them can engage the non-conducting portion of the switch at a time, connections from the members of one circuit-closer leading respectively to the feed-wire and to the working-conductor section to which the same controller belongs, and connections from the members of the other circuit-closer leading respectively to the ground or its equivalent and to the electric actuating device of the controller belonging to the next section of the working conductor, substantially as described.

4. An electric railroad provided with a working conductor made in sections insulated one from the other, a solenoid for each conductor-section and having its coil of wire connected with the said conductor-section and with the ground, the magnetic plunger of the solenoid being provided with alternately-arranged sections of conducting and non-conducting materials, sets of contact-plates engaging the plunger-sections, one set of the contact-plates being in the ground-wire for the preceding solenoid and the other set being in the wire for connecting the conductor-section with a feed-wire, substantially as shown and described.

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