(No Model.) 2 Sheets—Sheet 1.

# J. HOFFMAN.

## UNDERGROUND TROLLEY SYSTEM.

No. 565,985. Patented Aug. 18, 1896.

Fig. 1.

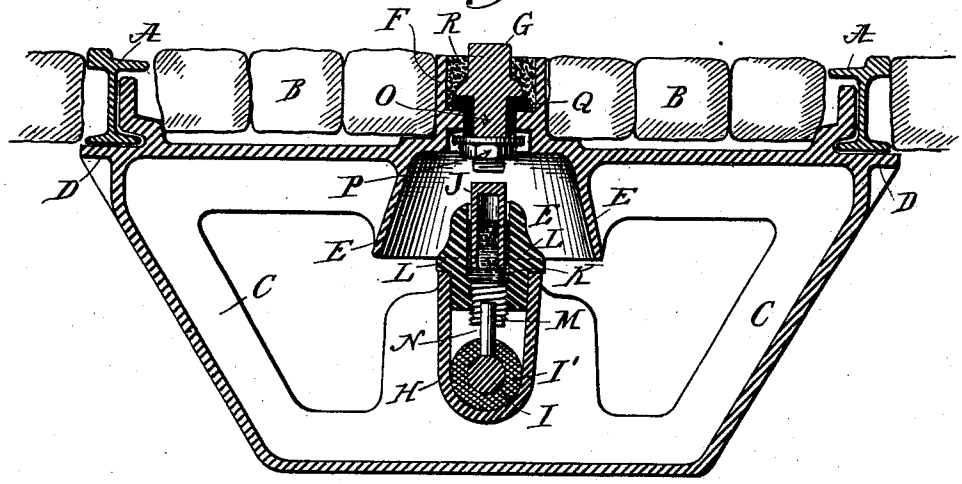
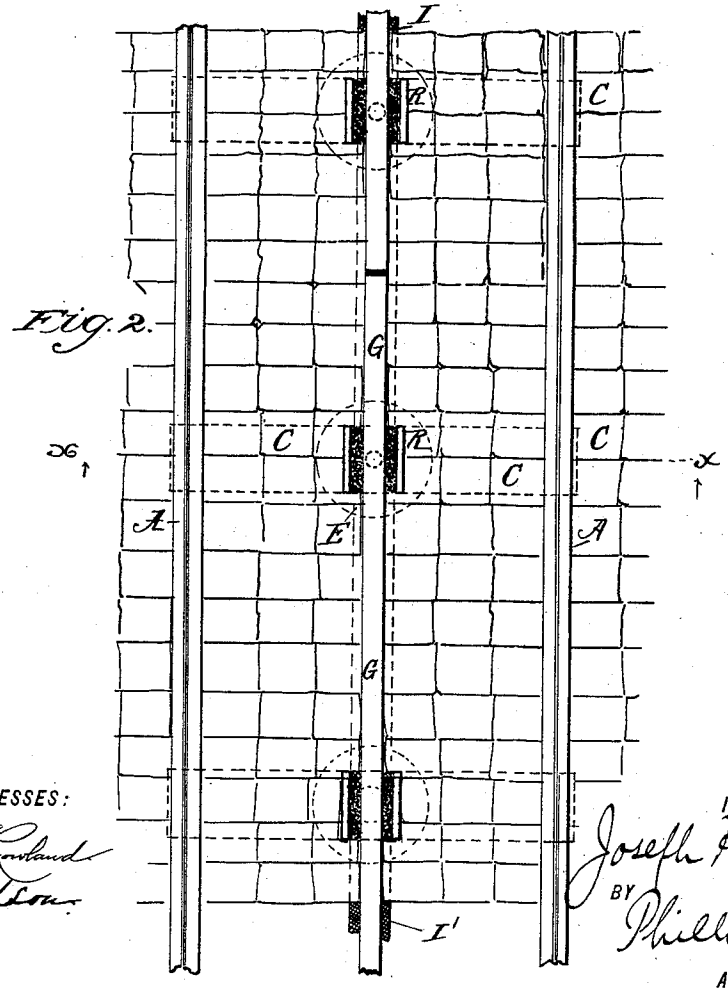



Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

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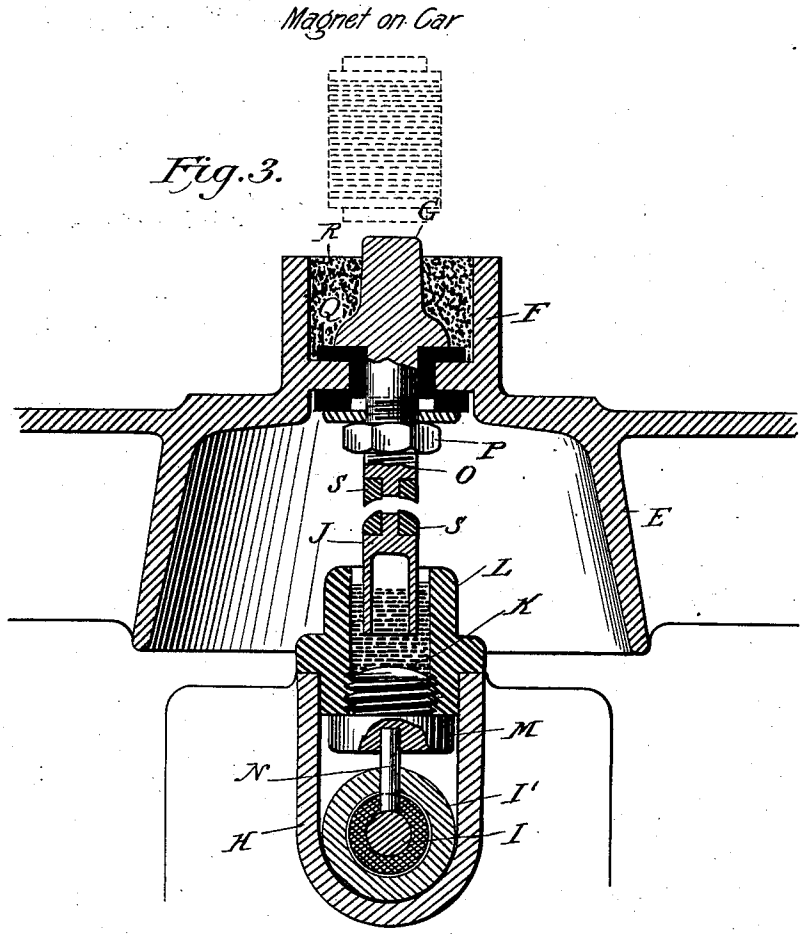
## UNDERGROUND TROLLEY SYSTEM.

No. 565,985. Patented Aug. 18, 1896.

Fig. 3.

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# UNITED STATES PATENT OFFICE.

JOSEPH HOFFMAN, OF SCHENECTADY, NEW YORK.

## UNDERGROUND-TROLLEY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 565,985, dated August 18, 1896.

Application filed September 20, 1895. Serial No. 563,074. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH HOFFMAN, a citizen of the United States, and a resident of Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Underground-Trolley Systems, of which the following is a specification.

My invention relates to improvements in underground-trolley systems of the "closed-conduit electromagnetic-contact" type, in which the current carried by an underground feeding-wire is automatically switched onto a section of the contact-rail by means of electromagnetic circuit-closing devices which respond to the attracting force of magnets carried by the car; and it consists in the employment of mercury for effecting a permanent but flexible metallic electrical connection between the movable part in said circuit-closing device and the feeder-wire.

Referring to the drawings hereof, Figure 1 is a transverse vertical sectional view of the invention on the line X X of Fig. 2. Fig. 2 is a longitudinal plan view of the invention. Fig. 3 shows the details of the contact-pieces.

A A are the track-rails; B B, paving-stones, concrete, or other material composing the road.

C C are frames which are spaced along the track at such distance apart that at least two of them will at all times be under a passing car. These frames are of cast-iron, and may be so constructed as to embody at their lateral extremes seats D D for the track-rails, although this is not essential, and at their central part they have an inverted-bell-shaped structure E, having an upwardly-extending frame F, which supports the contact-rail G. The frames in their grooved bottom portions H also support a conduit I', which extends from frame to frame, being a continuous water-tight duct or tube which carries the insulated current-conveyer or feeding-conductor I.

J is a movable contact-piece made of some magnetic material, preferably of soft iron, in the shape of a deep inverted cup or cylinder, the mouth of which dips into and rests in a quantity of mercury K, which is contained in a receptacle L, of porcelain or other suitable insulating material. The receptacle is closed at its bottom by a metallic plug M, which is electrically connected to the current-conveyer or feeder-wire I by means of short wires or studs N.

The contact-rail G is fastened to the frames by means of lugs or extensions O, which occur wherever the frames are located. They project downwardly from the contact-rails and are secured thereto by means of nuts P. In passing through the flange of the frame pivoted for the support of the rails the lugs O are insulated from them by means of a non-conducting bushing of any suitable insulating material Q. This is not essential, however, as the frames may be so arranged as to be otherwise insulated from the ground return-circuit. The space between the contact-rail G and the upwardly-projecting central parts F of the frame C is filled with cement or similar material, as shown at R. The central portion of the frames over the contact device is preferably made in the form of an inverted bell for the protection of the contact devices. *x*, Fig. 3, illustrates, diagrammatically, in dotted lines the magnet carried by the car.

In order to insure as perfect electrical contact as possible between the stationary polar extensions O of the contact-rail and the movable contact-pieces J, the lower extreme of the former is preferably made of a concave and the upper end of the latter of a convex shape, so as to guide the movable contact in ts central position, in which the contact offers the largest area, and brass or copper tips S S are provided, which prevent poor contact due to the oxidation of the contact-surface. The said tips S are made to project slightly beyond the iron contact parts to avoid their direct touching, thereby preventing the contact from sticking after the magnetizing-current has ceased to flow. If a light piece of iron is in contact with the poles of the electromagnet the remanent magnetism of the latter which remains in its core after once strongly magnetized may be sufficiently powerful to keep the piece of iron attracted, but if a gap of air or thin layer of non-magnetic material is inserted between the electromagnet and the piece of iron the latter will drop at the instant the current is turned off in the former.

The operation of the system is as follows: Each car carries an electromagnet, and is also provided with a contact wheel, brush, or equivalent device, sliding along the contact-rail G. As the car progresses, the electromagnet carried by it magnetizes the section of the contact-rail G immediately beneath it, and this in turn magnetizes the movable contact-pieces J just opposite to it, so that they move upwardly and make contact with the lower end of the lugs or extensions O. Thus a path for the current is established from the main conductor I, through the connecting wire or rod N, to the plug M, and thence through the mercury K and the movable contact-pieces J to the appropriate section of the contact-rail G, and thence through the trolley wheel or brush, which rests upon the rail, to the motor, thus actuating it.

The system may also be arranged as a "two-conductor" system, that is to say, two feeding wires I, two contact devices, and two contact-rails G, one serving as the lead-in conductor and the other as the return-circuit, may be provided in each frame.

It will be observed that under my system the feed-wire conductor is always stationary, and that the mercury-cups are likewise stationary; indeed, that the only movable parts of the device are the little inverted-cup-shaped contact-pieces which float upon the mercury within the mercury-cups, and that they are disconnected from anything else. Consequently there is no possible danger of injuring the conductor by continuous flexure of it, or of corrosion or rust preventing the operation of any part, or of wear by friction, or of moisture or freezing, or of any such obstruction derived from the elements interfering with the operation of the system, and that the simplicity, economy, and practicability of my invention are as perfect as is possible, when the essentials of such a system are considered.

It will be seen by those who are familiar with this art that modifications may be made in the details of construction without departing from the essential features of my invention. I therefore do not limit myself to such details.

I claim—

1. The combination of a stationary, insulated, electric feed-wire, stationary, insulated mercury-cups spaced along said feed-wire and provided with metallic plugs which permanently connect, electrically, the mercury contained in said cups with the feed-wire, an insulated, sectional contact-rail, and magnetically-actuated, movable, contact devices, connecting the mercury in the cups with the rail, for the purposes set forth.

2. A frame for underground-trolley systems, comprising a centrally-located support for the conduit, which contains the feeding-conductor, a continuous, insulated bridge or support for an insulated contact-rail, and a hood or bell supported from the bridge, which incloses the contact-points within the frame, for the purposes set forth.

3. A casing or frame for underground-trolley systems, embodying the lateral supports for the track-rails, a central bridge or support for the contact-rail, insulating material between the contact-rail and said bridge, a movable contact device electrically connected with the feed-wire and adapted to make contact with the contact-rail, and a hood or bell supported from said bridge for the protection thereof, for the purposes set forth.

4. A magnetically-actuated contact device, consisting of a polar lug or extension from the insulated contact-rail, a hollow and inverted metallic contact-piece such as soft iron, nickel, &c., resting in and supported by mercury contained in an insulated cup or receptacle, said cup or receptacle itself, and means whereby the mercury is in permanent electrical connection with the feed-wire, for the purposes set forth.

Signed at Schenectady, in the county of Schenectady and State of New York, this 14th day of September, A. D. 1895.

JOSEPH HOFFMAN.

Witnesses:
WM. W. WEMPLE,
MARCUS WING.