

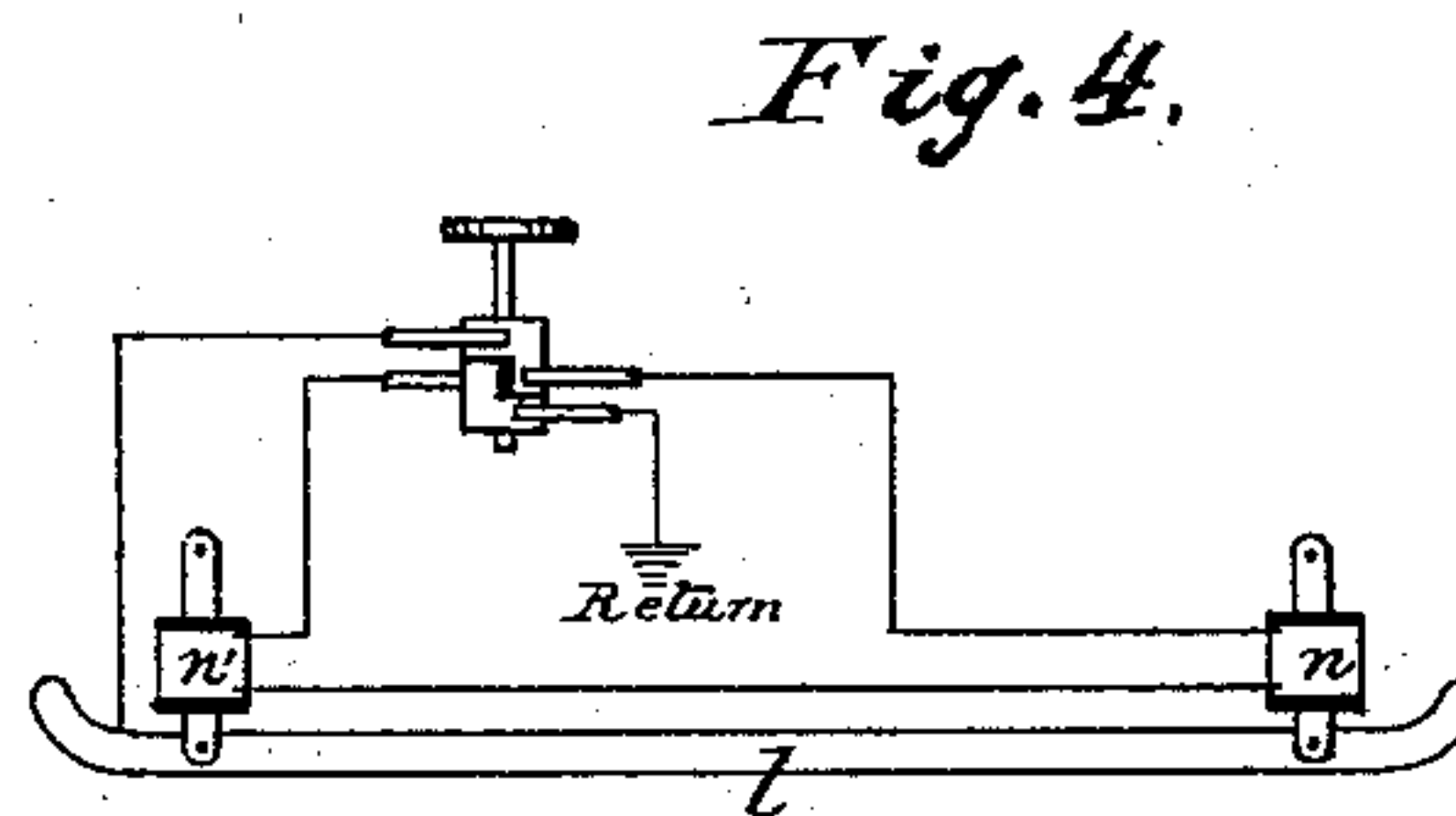
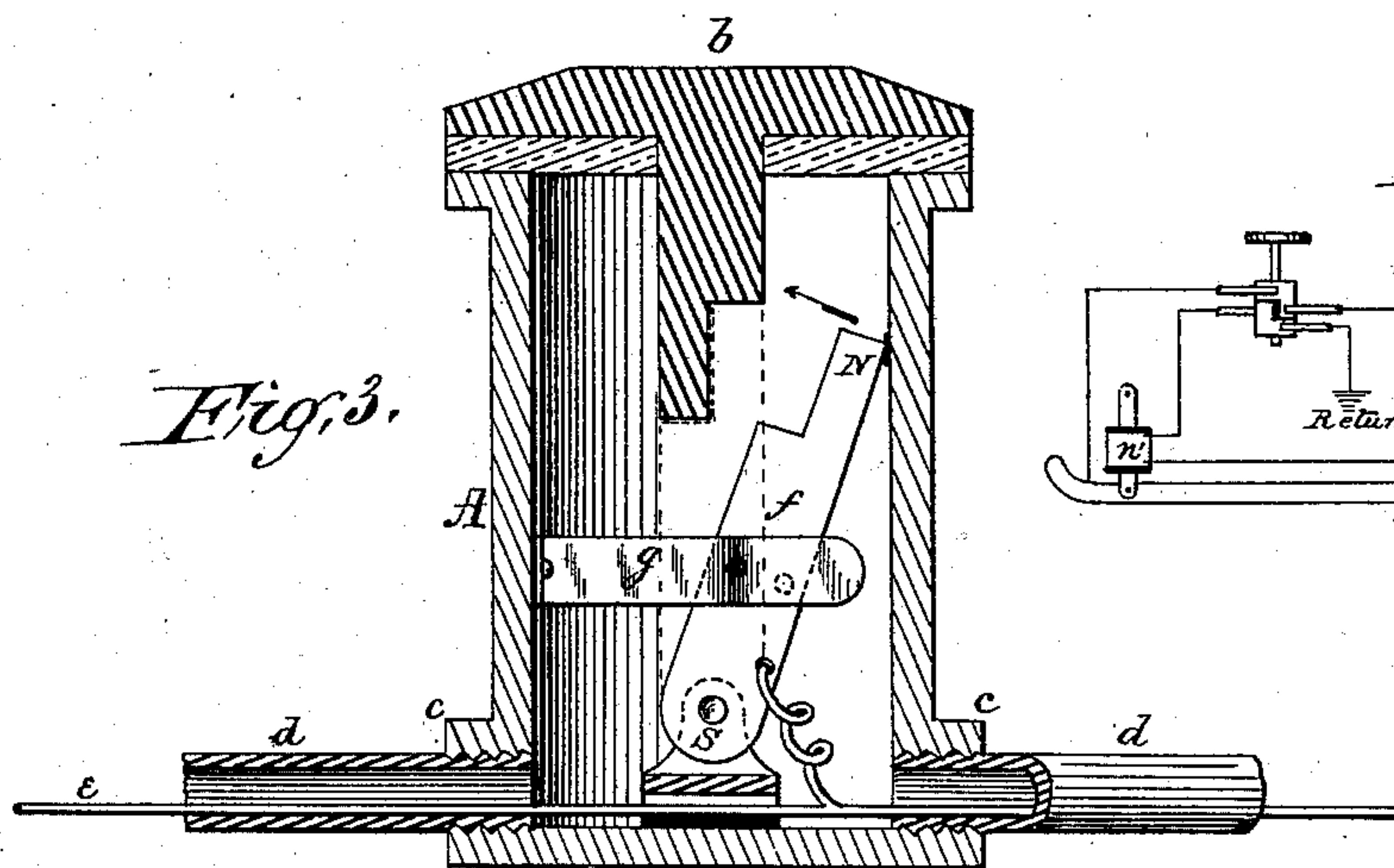
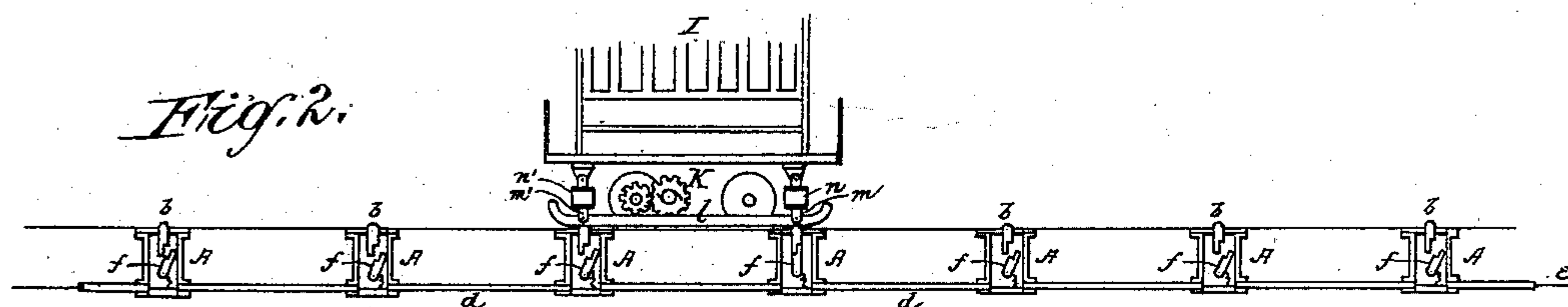
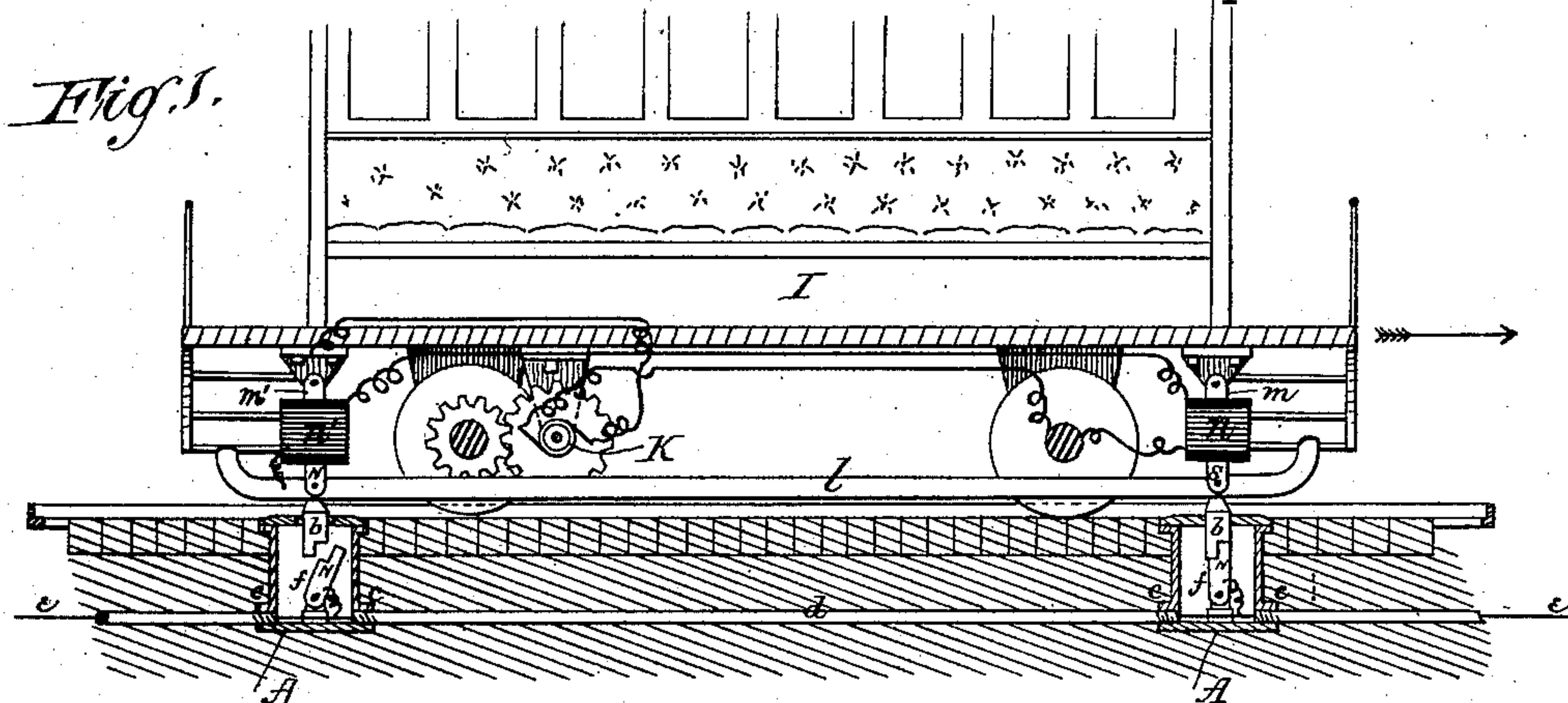
(No Model.)

J. D. NICHOLSON, W. J. McELROY & T. J. McTIGHE.

ELECTRIC RAILWAY SYSTEM.

No. 389,822.

Patented Sept. 18, 1888.



WITNESSES:

W. Benjamin
J. C. Spaulth

John D. Nicholson,
William J. McElroy
Thomas J. McTighe } INVENTORS

BY

McTighe & Worthington
ATTORNEYS

UNITED STATES PATENT OFFICE.

JOHN D. NICHOLSON AND WILLIAM J. McELROY, OF PITTSBURG, PENN-
SYLVANIA, AND THOMAS J. McTIGHE, OF NEW YORK, N. Y.

ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 389,822, dated September 18, 1888.

Application filed December 24, 1887. Serial No. 258,899. (No model.)

To all whom it may concern:

Be it known that we, JOHN D. NICHOLSON and WILLIAM J. McELROY, citizens of the United States, residing at Pittsburg, in the
5 county of Allegheny and State of Pennsylvania, and THOMAS J. McTIGHE, a citizen of the United States, residing at New York, county and State of New York, have invented certain new and useful Improvements in Elec-
10 tric-Railway Systems; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it ap-
15 pertains to make and use the same.

This invention relates to that special class
15 of electric-railway systems in which an insulated underground conductor is maintained in connection with the motor by the contact of a contact-bar on the car with isolated spots pro-
20 jecting slightly above the ground-level in the path of said bar, such spots becoming active or in circuit only when the car is above them. A type of such an electric-railway system is shown
25 in United States Patent No. 363,250, issued to two of the present applicants May 17, 1887. In said patent the contact-spots are rendered active or alive by electro-magnetic switching
30 devices contained in boxes below the spots and energized by being made successively parts of a derived circuit.

The object of the present invention is to
simplify the construction of such boxes, avoid
the complications of such electro-magnetic
35 switching devices and the possibility of damage by sparking at the various contacts required
40 in the boxes, and at the same time secure a positive and reliable action and co-operation of all the operative members of the system.

The invention consists in the arrangement
40 and combination of devices substantially as hereinafter fully described and claimed.

In the accompanying drawings, which con-
stitute part of this specification, Figure 1 is a
longitudinal section of a street-railway and
45 motor car with two contact-spots, the contact-bar having just reached one and being about to leave the other. Fig. 2 is a diagrammatic
extension of Fig. 1, embracing a number of
50 contact-spots. Fig. 3 is a vertical section of a simple form of box for containing the contact

devices, and Fig. 4 is a diagram showing the reversing arrangements.

It may be well to state that in the operation
of this system the car-motors will be in mul-
55 tiple arc between the supply-main and the re- turn, the former being the positive and placed underground, and the latter arranged in any
suitable manner; but we prefer to use the or-
dinary rails for the purpose.

A designates the switch-boxes sunk in the
60 street, and each furnished with an iron or steel contact spot or plug, *b*, projecting up- ward slightly, and downwardly into the box A, the plug *b* being insulated from the box. Each box A is cast with pipe-flanges *c* at
65 opposite sides of its bottom, which flanges are screw-threaded to receive the connecting-pipes *d*, which form an air and water tight conduit for the supply-conductor *e*, which we prefer
70 to have of lead-covered wire.

In each box A we pivot, on an insulated
bearing, a permanently-magnetized steel bar,
75 *f*, and connect each bar *f* permanently with the main conductor *e*. The mounting of bar *f* is such that it will tend to gravitate to one
side of the box, being prevented from contact
by an insulation-buffer suitably located; and
when the bar is in vertical position it makes
80 contact with its corresponding spot or plug *b*, and the contact is good, because the parts are
strongly held together by magnetism. All
the bars *f* are magnetized similarly—say with
N polarity uppermost and S polarity below,
as shown in the drawings.

A friction-spring, *g*, is arranged to bear
85 against the bar *f* slightly, having a projection or detent, and the bar having two slight de-
pressions situated at the limits of movement of the bar, the tension of the spring being merely
sufficient to maintain the bar against being, on
90 the one hand, jolted into contact with plug *b* by shocks from vehicles passing overhead, and, on the other hand, when in contact with
plug *b*, falling away from it until forced by the
operation of devices on the car. The normal
95 position of the bars *f* is out of contact with
plugs *b*, the residual magnetism of the bars being insufficient to attract them toward the
plugs *b* at such a distance. There are no other
100 devices or switching mechanism in the boxes A.

The car *l* is provided with an electric motor, *K*, of any suitable size, type, and arrangement of gearing to give motion to the car. Beneath or at one side of the car we suspend the contact-bar *l* by suitable pivoted or spring hangers. Our preference, however, is for the arrangement shown in Fig. 1, the hangers *m* *m'* being of soft iron and the bar *l* of hard bronze of sufficient length to span at least two of the contact-plugs *b*. The iron hangers are preferably slotted at their lower ends, so as to straddle the bar *l* and reach substantially to its lower edge, whereby in passing the plugs *b* they are brought into very close proximity, and can thus exert a powerful inductive action. Each iron hanger *m* *m'* is surrounded by an exciting-helix, *n* *n'*, as shown, the two helices being connected in a derivation between the main supply-wire *e* and the rails or return, as hereinafter explained, and they are therefore wound to high resistance, so as to absorb as little energy as possible within the limits of their office. The connections are such that the two helices induce opposite polarities in their respective lower ends, as indicated by the letters *N* and *S* in the figures, the polarity presented by the forward magnet being opposite to that permanently exhibited by the upper ends of all the pivoted bars *f*. Hence as the car moves forward the front magnet, *m*, in passing over a spot-plug, *b*, induces *N* polarity in its upper end and *S* polarity in its lower end. The *N* pole of bar *f* is instantly strongly attracted and flies over into contact with the plug *b*, as shown at the right of Fig. 1. The plug so touched becomes alive, and current can pass through it into the bar *l*, whence it passes through the motor *K*, and returns to the generator by means of the car wheels and rails, or otherwise, as the car moves forward. The bar *f*, which thus made contact with its spot, is held in contact by its own magnetism, and is assisted by the detent or spring *g*, and the contact remains till, just as the forward magnet has reached the next plug, *b*, in advance, the rear magnet, *m'*, gets within inductive proximity to the spot which has been previously rendered alive; but the inductive action is the reverse now, as the *N* polarity of magnet *m'* induces *S* polarity at the top of that plug *b*, and *N* polarity at its bottom, which repels the similar polarity of the pivoted bar *f*, which has been in contact, and such contact is forcibly broken just as the long contact-bar is about to leave that spot behind. Thus the bar *l* will always have at least one live-spot contact below it; but all those in front and behind will be dead—*i. e.*, out of contact with the main conductor *e*. The condition, therefore, is that along the whole railway, though the contact-spots *b* will be only fifteen or eighteen feet apart, all will be dead or uncharged except those immediately under the sliding bars *l* of the various cars in transit. Hence with a properly-insulated main *e* underground there is absolutely no possibility of shock to

animals or pedestrians. The bar *l* being always alive, the derived circuit containing the helices *n* and *n'* is taken from it and ends at one of the axles or wheels of the car, as shown. 70

To enable the car to be run either forward or backward, a reversing-switch is provided, as indicated at Fig. 4, which, when operated, will reverse the direction of current through both helices, and consequently reverse the polarity of their cores *m* *m'*, in which case the core *m'* will be the attracting and core *m* the repelling medium for respectively making and breaking contact between bars *f* and plugs *b*. As the electric motor must be reversed to drive the car the other way, the reversing mechanism may be fitted so that the one operation will also reverse the polarities of the magnets *m* and *m'*. The specific method of doing this lies in the province of the mechanical constructor, and is not of the essence of this invention. 85

In the contingency of the car becoming derailed and the contact-bar failing to reach the spots or plugs *b* it is probable that one of the spots will still be active or alive, in which case a temporary connection can be readily made between it and the bar *l* and the motor and rails, so as to provide the motor with current; but if it should happen that no neighboring spot *b* is alive at the time, a powerful permanent magnet presented to any spot will immediately render it active. Such a magnet could be permanently carried by each car without great expense. So that no matter what contingency or accident may happen, so long as there is current on the main supply-conductor, the car-motor can always be furnished with current for operation. 95

We do not herein lay claim, broadly, to the combination of an insulated main conductor, discontinuous surface conductors, and a magnet on the car adapted in passing to connect said main and surface conductors, as such forms the subject-matter of another application filed by two of the present inventors, Serial No. 267,718. 105

We claim as our invention—

1. In an electric-railway system, an insulated main conductor in a closed conduit, in combination with a series of insulated contact plugs or spots of magnetizable metal distributed apart along the surface, a pivoted magnet adjacent to each permanently connected to the main conductor, but normally out of contact with its plug and adapted to be brought into contact therewith by external magnetic induction, a magnet carried by the car in inductive proximity to said plug, and a contact device on the car adapted to connect with said plug. 120

2. In an electric-railway system, the combination of an insulated underground main conductor, a series of boxes containing each a pivoted magnet connected with said main conductor and having a magnetizable metal plug or cap in inductive relation to said magnet, but 130

normally disconnected therefrom, a motor-car having a contact-bar capable of spanning and touching two such metallic plugs at once, and an electro-magnet on said car having one pole in inductive reach of said plug, substantially as described.

3. In an electric-railway system, an insulated underground main conductor, a series of boxes, each containing a pivoted magnet connected with said main conductor, and having a magnetizable metal plug or cap at the surface, with its inner extremity in inductive relation to said magnet, but normally out of contact therewith, all of said pivoted magnets presenting their like poles similarly, in combination with a motor-car carrying a contact-bar capable of spanning two such metallic plugs at once, and two electro-magnets presenting their poles in inductive proximity to said plugs, the forward pole presenting polarity opposite in kind and the rear magnet-pole presenting polarity of like kind to that of the swinging pole of the pivoted magnets, substantially as described.

4. In an electric-railway system wherein current is conveyed to the motor of the car by means of discontinuous surface conductors alternately made active and inactive by the attractive and repulsive action of two electro-magnets on the car, whereby the car is propelled in a given direction, the combination, with said electro-magnets, of a current-reverser in their circuit adapted to change the direction of current and consequently reverse the order of attractive and repulsive action of said magnets.

5. The combination of the motor-car, its electro-magnets n m and n' m' , disposed as described, diamagnetic contact-bar l , with the magnetizable plugs b , and swinging magnets f ,

permanently connected to the main e , substantially as described.

6. The combination, in box A, of the magnetizable plug b , swinging magnet f , and a detent adapted to retain the magnet f in either of two positions against displacement by shock or jolting.

7. In an electric-railway system, the combination of an insulated main conductor, a series of discontinuous working conductors, devices for connecting and disconnecting said main and working conductors, dependent for respective operation upon opposite magnetic conditions, and two inducing-magnets on the car arranged to successively present such opposite conditions thereto.

8. In an electric-railway system, the combination of an insulated main conductor, a series of disconnected working conductors, interposed polarized switching devices adapted to connect and disconnect said conductors and respectively dependent for operation on inductive attraction and repulsion, and two magnets on the car arranged to present in passing different polarities toward said switching devices, whereby as the car progresses each switch is twice operated—first, to make the connection, and, secondly, to break it.

In testimony whereof we affix our signatures in presence of witnesses.

JOHN D. NICHOLSON.

WM. J. McELROY.

THOMAS J. MCTIGHE.

Witnesses as to J. D. Nicholson and W. J. McElroy:

CARL CAPPEL,

S. C. EDWARDS.

Witnesses as to Thomas J. McTighe:

CHAS. W. PRICE,

LOREN N. DOWNS.