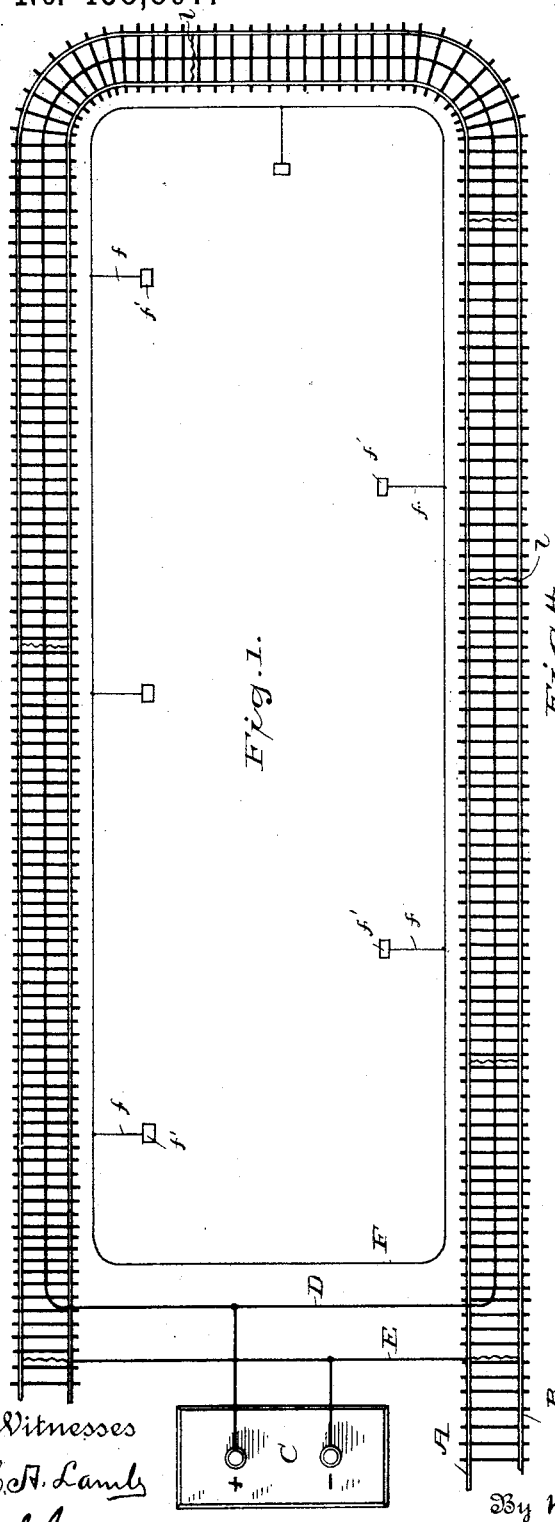
(No Model.) 2 Sheets—Sheet 1.

C. J. VAN DEPOELE.

SYSTEM OF ELECTRIC RAILWAY CONDUCTORS.

No. 458,867. Patented Sept. 1, 1891.



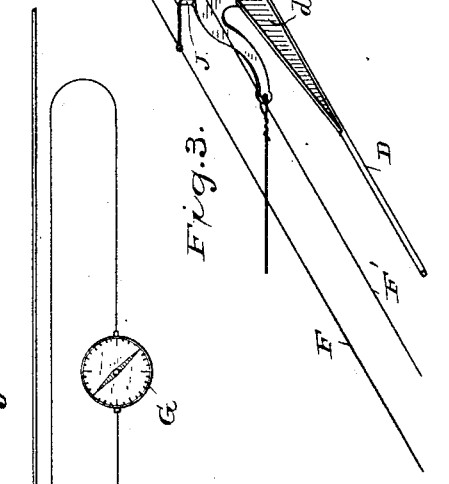


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Fig. 6.

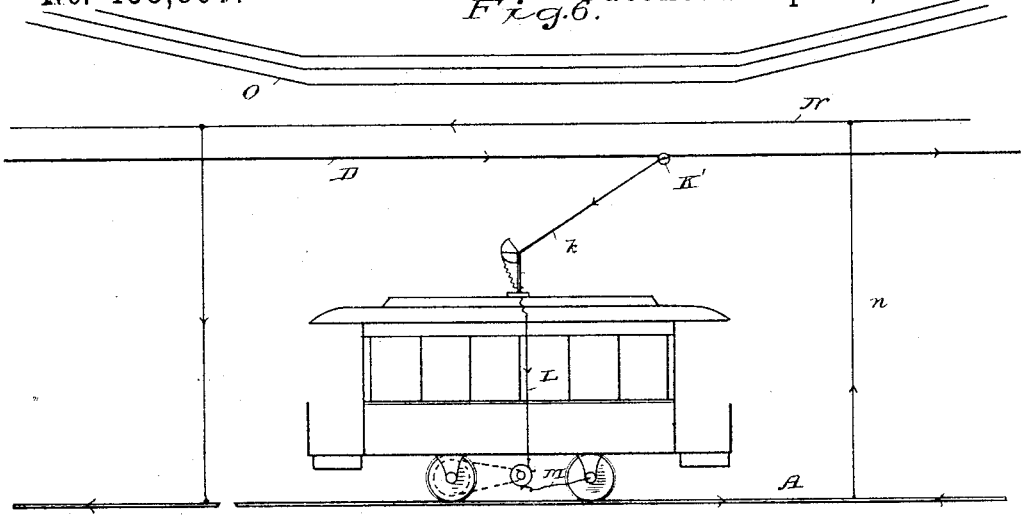


Fig. 7.

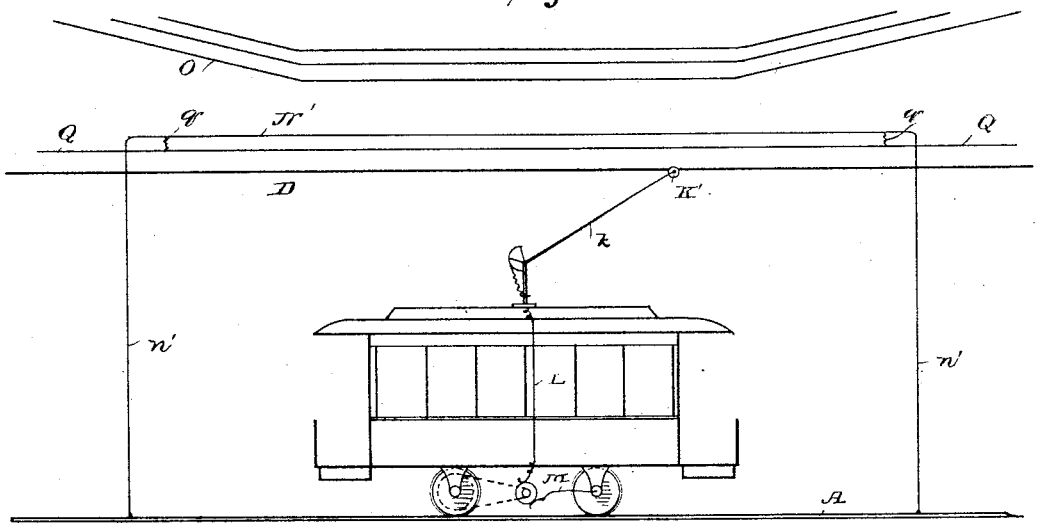
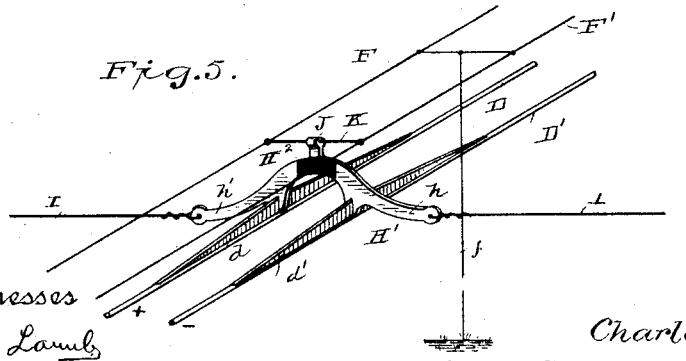


Fig. 5.



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UNITED STATES PATENT OFFICE.

CHARLES J. VAN DEPOELE, OF LYNN, MASSACHUSETTS.

SYSTEM OF ELECTRIC-RAILWAY CONDUCTORS.

SPECIFICATION forming part of Letters Patent No. 458,867, dated September 1, 1891.

Application filed July 19, 1889. Serial No. 317,988. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Systems of Electric-Railway Conductors, of which the following is a description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to improvements in electric railways of the type in which the current for operating the motor upon the motor-cars is collected by a traveling device engaging a bare working conductor suspended above or along the line of the railway.

The invention is applicable also to other uses and to other systems of conductors; but I will describe the same in connection with a system of electric railways such as just referred to.

The invention is based upon the fact that a current flowing in a conductor will, by induction, produce electrical disturbances in parallel conductors. This action is frequently the cause of trouble in circuits of conductors strung along the line of the railway.

The object of my invention is not to prevent induction, this having been attempted in many ways without success, but, so to speak, to absorb the inductive effect of the electric-railway conductors, and in that manner prevent said inductive effect from extending to and injuriously affecting other circuits which may be in proximity thereto, as telegraph, telephone, fire-alarm, and others.

The invention can be carried into effect in various ways, some of which are shown in the accompanying drawings.

The details of construction and arrangement will be hereinafter fully set forth, and referred to in the appended claims.

Figure 1 is a diagrammatic view of a portion of an electric railway provided with an induction-absorbing circuit according to my invention. Fig. 2 is an enlarged detail view showing the usual manner of arranging the wires in practice. Fig. 3 is a view similar to Fig. 2, differing therefrom only in the employment of two induction-absorbing circuits instead of one. Fig. 4 is a diagrammatic view showing a portion of the system. Fig. 5 is an enlarged detail view differing from Figs. 2 and 3 in the employment of a double set of conductors, both main and protective. Fig. 6 is a view, in elevation, showing a portion of an electric railway to which the invention has been applied. Fig. 7 is a view similar to Fig. 6, but showing a somewhat different arrangement.

As indicated in the drawings, A B are the rails of a portion of an electric railway and are shown in the form of a loop for convenience of illustration.

C is the generating station or source of current for the working conductors of the railway.

D is the main conductor, suspended along the line of travel and in most instances directly above the center of the track.

E is the return-conductor, connected to the other side of the circuit, which, as here indicated, is formed by the rails of the railway. Under some conditions the rails are suitably connected at their extremities to form a continuous conductor, and may also be connected at intervals by cross-connections *l*, in order to insure the continuity of the return-circuit and to diminish its resistance. Just inside the track A B in Fig. 1 is seen a conductor F, the ends of which are connected so that it forms a closed circuit, which said circuit is placed in inductive relation to the main conductor D. The main conductor D is itself also shown as a closed circuit in order to more fully illustrate the principles involved in the invention. It will be apparent that if the circuit F is arranged near to the circuit D that current impulses passing in the circuit D will induce secondary currents or electrical disturbances in the circuit F. Furthermore, the circuit F, being placed in much better inductive relation to the circuit D than any adjacent wires, will receive and absorb the inductive power of the said main conductor D. If now the currents generated in the conductor F are conveyed to earth by connections *f*, connected to the water or gas pipes or to suitable earth-plates *f'* or to the rails, the inductive effects of the passage of heavy currents upon the exposed conductor D will be absorbed and no disturbance will take place except in the circuit F, which, as stated, is provided for the express purpose of

receiving and disposing thereof. It may be desirable to construct the secondary circuit in links or comparatively short sections, substantially as indicated in Fig. 4, in which figure a galvanometer G is shown, by way of illustration, for the purpose of indicating the disturbing effect of the passage of the main current in the working conductor.

The invention is not limited to systems employing continuous currents, since it is equally applicable to systems in which alternating, pulsating, or intermittent currents are employed to furnish the electrical energy to the motors.

In Fig. 2 is seen a practical method of arranging the conductors of the system. The main conductor D is attached to the under side of an ear or bail *d*, which is connected with or attached to an arched support H, from the extremities of which extend the supporting cables or cross-wires I I, which, being secured to suitable supports, as poles placed along each side of the line of way, will sustain the conductor in desired position. The arch H is provided with a small extension J at its upper side, which is provided with a suitable insulator *j*, to which the secondary conductor F is secured. An earth connection *f* is seen extending from the said conductor F to the ground. A similar arrangement is indicated in Fig. 3, except that conductors F F′ are carried above the main conductor D by short insulated arms K, carried in the extension J. The two conductors F F′ may each represent a separate secondary circuit, or they may be connected at their extremities, so that both sides of the secondary circuit are in inductive relation to the main conductor. The ground connection *f* is also seen in this figure, said ground-wire being connected to both of the conductors F F′.

In Fig. 5 I have illustrated an arrangement resembling that seen in Fig. 3, except that two main conductors D D′ are therein seen, the said conductors D D′ representing opposite sides of the generator-circuit and conveying parallel currents in opposite directions, as described with reference to Fig. 6. Protecting-conductors are also shown in connection with this figure, the said conductors being desirable and useful in the position shown, whether they operate to diminish the inductive effects of one circuit upon another or not, since, being in proximity to the insulated main conductors D D′ and also being well connected to earth, they will serve as protectors against lightning, being in position to intercept atmospheric electricity and to convey the same to ground through a less resistance than would be found in the main conductors and the apparatus connected therewith.

The suspending device for duplex circuit may be an enlarged arched suspender H′, the two parts *h h′* of which are separated by a link piece or section of insulating material H^2, to which the support or arms K for sustaining the secondary or protective conductors are secured.

While I have shown and described the secondary circuit as a metal loop, it may be arranged as a closed circuit in any convenient or practical manner. For the purposes of this invention it is only essential that the said secondary wire or wires be so arranged and connected as to constitute a circuit in which induction can take place, whether by being united in any convenient manner metallically or by having both its ends grounded and its circuit closed through the earth or connected to the rails and closed through them and the earth.

Very little, if any, inductive effect is produced in neighboring conductors from currents flowing in opposite directions in two main conductors placed near together. Such an arrangement is illustrated in Fig. 6, where is seen an electric-railway system employing but a single set of overhead current-collecting devices connecting the motor-circuit with the suspended supply-conductor. The main supply-current is conveyed through conductor D, from which it is collected by trolley K′, passing thence down the trolley-arm *k*, or a conductor carried thereby, and by conductor L to the motor-circuit, and thence by conductor M to the metallic parts of the running-gear of the car and to the rails A.

In order to minimize the inductive effect of the current in the conductor D, a similarly-continuous conductor N is suspended in close proximity thereto. The conductor N is connected to the source of current and is arranged to constitute the other side of the main circuit, and consequently will be traversed by currents flowing in a direction opposite to those passing in the main-supply conductor D. The said conductor N is connected at suitable intervals by conductors *n* with the track A, which is divided into sections of any convenient length. In this manner the continuous flow of currents in opposite directions in parallel conductors is secured in what is known as a "single-circuit overhead system," and, as stated, by means of the arrangement just described the inductive effect is reduced to the minimum and with it the disturbance in adjacent electric circuits, such circuits being indicated by conductors O.

The arrangement seen in Fig. 7 differs from that just described, in that it is provided with two sets of conductors over the main wire, the conductors being, for convenience, arranged as indicated in Fig. 3. The electrical arrangement differs somewhat, in that the conductor N′ is arranged in sections of any desired length and is connected to the rails A by conductor *n′*, so as to practically form a closed circuit. Closed circuits, such as just described, are arranged in proximity to any adjacent conductors, as O, which it is desired to protect from the inductive effects of the

currents flowing in the main conductor D. With this arrangement the rail-circuit need not be severed, the anti-inductive effect being produced by the sections of conductor N′, which are placed in inductive relation to the main conductor D, so as to absorb the induction thereof, the said conductor N′ being formed into a closed circuit or circuits by the conductors n' and the rail or rails A, to which they are connected. It will of course be apparent that this arrangement does not differ materially from that seen in Fig. 2, in which the induction-absorbing wire F is grounded at suitable intervals, thereby divided into a number of closed circuits.

An additional feature is found in Fig. 7, consisting in the conductor Q, which is coextensive with the main conductor D and parallel thereto. The conductor Q will operate as an admirable protection from atmospheric electricity, and when connected to conductor N′ will aid in carrying off the secondary currents induced in the said conductor N′. The conductors N′ and Q are shown as being connected by wires q; but these may under some circumstances be omitted. It will readily be apparent that when conductors q are used the conductors n' might be dispensed with and the anti-induction circuit or circuits completed through conductors N′, Q, and q.

With an arrangement such as shown in Fig. 7 it will be apparent that the rail-circuit might also, in this case, be divided into sections and the conductor Q utilized as the return-circuit, being connected with the rails through the secondary conductor N′ and connections n'.

It will of course be understood that the conductors of which the secondary or auxiliary circuits are composed must be insulated from the main-supply conductor or conductors extending from the source of supply; but it is not necessary that the said auxiliary conductors be themselves covered or protected by insulating, and any ordinary cheap form of wire, as galvanized iron or steel, may be used for this purpose with good results, the main-supply conductor or conductors known as the "trolley-wires" being, of course, of the best hard-drawn copper,

Various minor modifications and changes may be made in my said invention without departing from the spirit or scope thereof.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a system of conductors for electric railways, the combination, with an exposed working conductor or conductors, of a conductor insulated from the primary or working conductor, said secondary conductor or conductors forming closed circuits in inductive relation to the working conductors, and grounded connections extending from said secondary circuit or circuits.

2. In a system of conductors for electric railways, the combination, with an exposed working conductor or conductors, of a secondary conductor or conductors having grounded connections and forming closed circuits in inductive relation to the main working conductors and located above or near the said main conductors and adapted to collect and discharge currents created by the variations of current in the main conductors.

3. In a system of conductors for electric railways, the combination, with exposed working conductors, of secondary circuits arranged in inductive proximity thereto and consisting of closed metallic circuits and grounded connections extending from said closed circuits.

4. In a system of conductors for electric railways, means for protecting suspended working conductors from atmospheric electricity, comprising a conductor or conductors forming a closed circuit or circuits insulated from the said working conductors, but arranged in proximity thereto, said auxiliary circuit or circuits being connected to earth and of less resistance than the working circuits of the system to be protected.

In testimony whereof I hereto affix my signature in presence of two witnesses.

CHARLES J. VAN DEPOELE.

Witnesses:
J. W. GIBBONEY,
CHARLES L. OECHSNER.