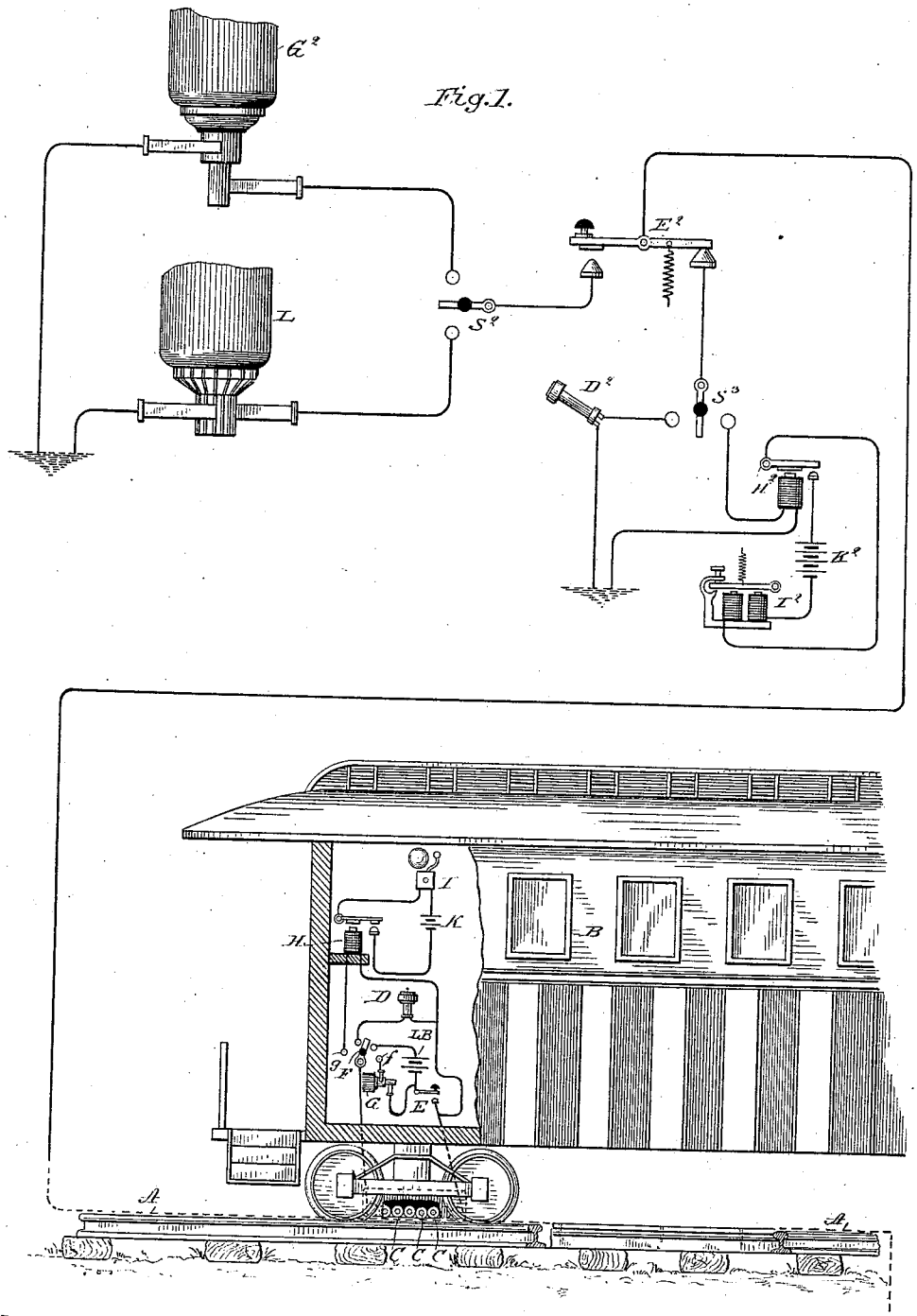
(No Model.) 2 Sheets—Sheet 1.

L. J. PHELPS.

COMMUNICATING TO AND FROM MOVING VEHICLES BY ELECTRICITY.

No. 307,984. Patented Nov. 11, 1884.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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COMMUNICATING TO AND FROM MOVING VEHICLES BY ELECTRICITY.

No. 307,984. Patented Nov. 11, 1884.

Fig. 2,

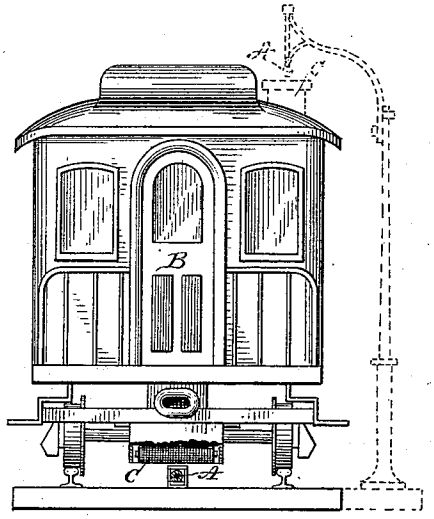


Fig. 3.

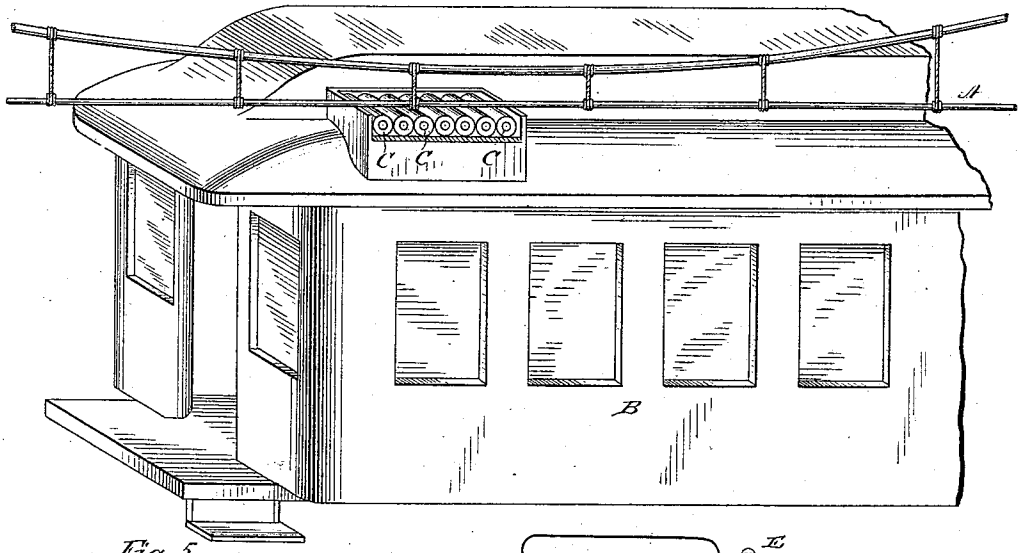


Fig. 5.

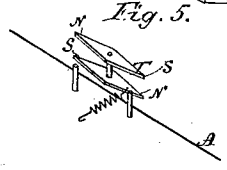
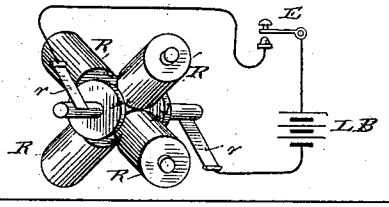
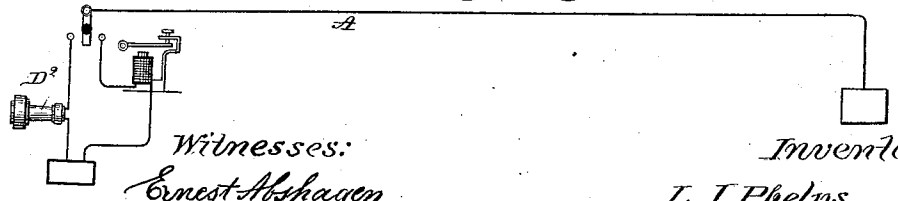


Fig. 4,





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UNITED STATES PATENT OFFICE.

LUCIUS J. PHELPS, OF NEW YORK, N. Y.

COMMUNICATING TO AND FROM MOVING VEHICLES BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 307,984, dated November 11, 1884.

Application filed March 13, 1884. (No model.)

To all whom it may concern:

Be it known that I, LUCIUS J. PHELPS, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Communicating to and from Moving Vehicles by Electricity, of which the following is a specification.

My invention relates to systems of electric communication between moving railway-trains, or between a moving railway-train and a fixed station, and its object is to avoid the necessity for employing contact brushes or wheels or other devices to keep up an electric connection between the moving vehicle and a line-conductor placed beside, beneath, or over the vehicle. In the ordinary systems of communication, signals are transmitted to and from the moving vehicle by preserving direct electrical connection between the vehicle and a suitable conductor, consisting of a rail or wire placed between or beside the railway-rails, or hung from other suitable supports above the track. These systems employ as a means of preserving the electrical connection a brush, wheel, or other contact, which travels in constant contact with the conductor.

My invention consists in dispensing with all traveling contacts, brushes, or wheels, and in transmitting the signal to and from the vehicle by induction, (either current-induction or electro-magnetic and magneto-electric induction,) or by any other inductive effect known to electricians, whereby a current flowing in the line-conductor may be made to produce inductively electrical or magnetic effects upon suitable devices arranged upon the car or vehicle and in suitable proximity to the line-conductor. In my system suitable inductive proximity to the line-conductor is all that is required, and electrical contact with said conductor becomes entirely unnecessary. I may, therefore, and in some cases I prefer to make use of a line-conductor inclosed in an insulating covering or sheath.

By rendering possible the use of a conductor entirely insulated I avoid the difficulties hitherto experienced in insulating the exposed conductor from the earth. An element of my system is the employment upon the moving car of suitable means for producing by induction (electric or mageto-electric) electric currents in the line-conductor. Such means may either be the means whereby currents on the line-conductor induce currents in a circuit upon the vehicle, or may be supplemental devices acting by the inductive influence of a magnet or magnetic field upon a conductor transverse to the magnetic lines of force to set up in the line-conductor electric impulses. I sometimes employ a device of the latter kind where it is desirable to induce currents of considerable strength, so as to act upon a signal-bell at a fixed station or upon another car.

Any means or method of communicating by electricity may be employed in carrying out my invention. I ordinarily employ the Morse system of telegraphy, but may use others. As a receiver I prefer to use some form of receiving-telephone on account of its well-known sensitiveness to induced currents.

The principles of my invention admit of the use of any system of telegraphy or telephony, and I do not, therefore, restrict myself to any particular system, but claim, broadly, the employment, in combination with any system of communication by electricity, of means for sending or transferring the signaling-impulses inductively between a line-conductor and a moving vehicle moving in proximity to but out of electrical connection with said conductor, and provided with a closed electric circuit some portion of which is in proximity to said conductor.

The principles of magneto-electric and electro-magnetic and current-induction being well known to electricians, I need not describe in detail all of the ways in which the principles of such inductive action may be utilized for the purposes of my invention. It only need be said that in any case, in order to follow out the principles of my invention, the line-conductor, arranged parallel to the way over which the vehicle travels, forms one of the elements of the device by which such inductive actions may be made manifest, and that the other is in closed electric circuit and is carried by the moving vehicle and in suitable proximity or relation to said conductor.

In the accompanying drawings, Figure 1 is a diagram of circuits and apparatus illustrating one way in which my invention may be carried out. Fig. 2 is an end view of the rail-

way-car shown in Fig. 1. Fig. 3 is a perspective view of a modification. Fig. 4 shows an equivalent way of inducing electric currents in the line-conductor. Fig. 5 illustrates in plan an equivalent induction apparatus, whereby signals on the line-conductor may be inductively transferred to the moving vehicle without electrical conducting connection.

Referring to Fig. 1, A indicates an electric conductor arranged parallel with the track or path over which a railway-car or other vehicle, B, moves. Said conductor is suitably insulated in any desirable way known in the art—as by supporting it upon suitable insulated supports or by inclosing it in an insulating sheath or envelope of any suitable insulating material. Said conductor may be arranged on the road-bed, as indicated in Fig. 2, beneath the car, or may be suspended above the car from poles or posts, as indicated in Fig. 3. It is by preference placed in a suitable covered box or trough to protect it from injury, as indicated in Fig. 2, and it forms a portion of a circuit the return-connection for which is made through the earth or in any other suitable way. In this conductor are produced the currents by which electrical communication with the moving car is obtained, and said conductor forms one element of the induction apparatus, the other element of which (electric or paramagnetic) is carried by the vehicle B.

As the best device now known to me whereby currents in the line-conductor may induce signals on the car, and as one particularly adapted for use when a telephone on the car is employed as a receiver, I have herein shown coils of wire C, (one or more,) arranged with their axes transverse to the conductor A, and carried in such proximity to the conductor that the currents in the latter will induce currents in the coils. In practice, and for the transmission and reception of signals by the telephone, a proximity of two or three inches will be sufficient. To heighten the effect, I place in each coil C a bar of iron, constituting the core of a magnet, to which the coils bear the relation of magnetizing-helices. The coils C are connected in any desired order or relation, but preferably in series, with a local circuit upon the car containing the signaling and communicating apparatus employed, which circuit is a normally-closed circuit, in order to permit a current on the line to induce a current in said local circuit. In the present instance I have shown a telephone, D, as the receiver for signals sent by the Morse code, and a Morse key, E, for sending a communication from the moving vehicle to another vehicle moving over the same conductor A, or to a fixed station provided with suitable apparatus, to be presently described. A switch, F, of any suitable or usual construction, serves to throw the receiver D and the transmitter E into and out of circuit with coils C, according as a communication is to be sent or received.

In the circuit with the transmitter and coils C is a generator of electricity, L B—such as a galvanic battery—a continuous-current dynamo-machine, and other suitable apparatus. The impulses produced in this circuit by the closing and opening of the key E serve to produce by the coils C induced currents in the line-conductor A, which impulses are received by induction on similar apparatus on another vehicle, or are directly conducted to a suitable receiver—such as a telephone—at a fixed station. The impulses thus produced are ordinarily sufficient to permit a signal to be sent when the telephone at the distant point is to the ear of the operator; but it may sometimes be desirable to produce stronger impulses when the distant operator is to be called by the action of an ordinary electro-magnetic relay or call bell, or when it is desirable to receive the communication by an ordinary relay and sounder instead of by a telephone. For this purpose I propose to employ an alternating-current dynamo or magneto-electric machine of any suitable kind and driven by any suitable power. Such a device is indicated at G, and may at pleasure, when a call is to be sent or a communication is to be transmitted, be included in the circuit with coils C by means of the switch F, which latter has a third contact-point, *f*, connected to said machine. The rapid alternations of currents produced in the local car-circuit by the machine are sufficient to induce in the line-conductor A rapidly-alternating currents of considerable power, that will recur with sufficient rapidity to produce the practical effects of a continuous current in circuit A at the fixed station, and will, so long as the key E is closed, keep the armature-lever of the relay at such station drawn up and the local circuit closed. A similar dynamo may be used at the fixed station for calling the operator on the car or for sending a message to the same, and the latter may then be provided with an electro-magnetic signal bell or sounder, I, in a local circuit with a battery, K, said circuit being controlled in the usual way by a relay, H. By means of the switch F and a fourth contact-point, *g*, the latter may be included in the circuit with the coils C, and left normally in this condition ready for a call from the distant operator on another car or at a fixed station.

If it be desired to permit signaling from one moving train to another, similar apparatus to that described is provided on each train. The fixed station mentioned is also provided with similar apparatus to that already described, which apparatus is, however, represented in a somewhat modified arrangement. The same arrangement might be employed on the vehicle.

E^2 indicates a Morse key at the fixed station. Its normal or back contact connects with a switch, S^3, by which connection from line A may be closed either to a telephone-receiver, D^2, or to a relay, H^2, controlling the circuit of a local battery, K^2, and bell or sounder I^2 or other circuit or apparatus used

either for the reception of calls, of communications, or for the purpose of relaying the message to another circuit. When the switch S^3 rests on the contact leading to the relay H^2, the apparatus is in proper condition for the reception of a call from the moving vehicle. The relay H^2 may be of any desired kind. If designed to be used for the reception of a call sent by the dynamo G on the car or vehicle, it may be a polarized relay or receiver. The telephone D^2 is ordinarily used for the reception of intelligence sent by the key E upon the car. The key E^2 may be used either in sending communications or in calling up the distant operator on the vehicle, and for this purpose its front contact is by a switch, S^2, placed either in connection with a continuous-current dynamo-electric machine, L, or with an alternating-current dynamo-machine, G^2. When the switch S^2 is turned to connect with the dynamo L, the signals sent by the key E^2 or other transmitter are inductively transferred from the line A to the local circuit on the vehicle containing the receiver D or other instrument by means of the wire of coils C.

To call the operator on the vehicle, the alternating-current generator G^2 is thrown into circuit and the key E^2 operated. The rapid and strong alternations thus produced act inductively from the line A through the coils C and the local circuit connected with the latter and including the relay H or other device. Any other generators or sources of electricity might be used in place of those described.

In the modification shown in Fig. 3 the conductor A is shown as suspended above the moving vehicle and the coil C or other element carried on the vehicle beneath said conductor.

Instead of the arrangement already described for inductively transferring the signal from the moving vehicle to the conductor, I may employ the arrangement shown in Fig. 4.

A well-known method of making manifest the phenomenon of magneto-electric induction is to pass a conductor in closed circuit transversely through a magnetic field. A converse way is to cause the magnetic lines of force from the poles of a magnet or series of magnets to sweep transversely across the closed-circuit conductor. Such an arrangement is illustrated in Fig. 4, and may conveniently be used for calling the distant operator from the moving vehicle. It consists of a set of electro-magnets, R R, of any desired number mounted on a suitable axis arranged to rotate parallel with the line-conductor A, and to carry the poles of the magnets R in rapid succession transversely across and in close proximity to the conductor A. The coils of the magnets R are wound and connected so that their poles will be alternately north and south, and the energizing-current is supplied from a generator, L B, through springs *r r*, bearing on two suitable continuous conducting-surfaces rotating with the magnets and connected one to one terminal and the other to the other terminal of the coil-circuit for the electro-magnets. This method of making the connection with the revolving magnets is that usually employed in alternating-current dynamo or magneto-electric machines, and is well known to electricians. The key E controls the circuit of the coils and local battery in the usual way. It will of course be understood that the device Fig. 4 is designed simply to illustrate the principle of this portion of the invention, and not the actual size, shape, or proportions of the revolving magnets to be used in practice. In actual practice it will be obviously desirable to elongate the pole-pieces of the revolving magnets in a direction parallel to the fixed conductor, so as to expose as great a length of said conductor to the magnetic influence as possible. The receiving-instrument by which the impulses induced in said line-conductor by the revolution of the magnets shall be made audible may be of any desired construction adapted to be influenced by weak currents. If found necessary, a telephone-receiver might be used to make the sounds audible where by reason of escape, length of line, or other circumstances, unfavorable conditions are found to exist for the transmission of currents of great strength.

An equivalent device to that already described, whereby the signal of whatever kind may be inductively reproduced on the moving vehicle, is indicated in Fig. 5, and operates upon the well-known principle of electro-magnetic induction, the conductor A forming the one element of the induction apparatus in which the electric current circulates, and a magnet or other suitable device—such as the needle of a compass or galvanometer—the other element, the latter being carried by the vehicle. As is well known in the art, the influence of a current in the conductor tends to set the needle at right angles to the conductor. T indicates such a needle, which is preferably an astatic needle, one portion near the conductor and the other removed. It may control a local circuit or not, as desired.

A well-known equivalent of the needle would be a solenoid through which a constant current of electricity flows. The latter arrangements form the subject of special claims in another application for patent filed by me of even date herewith.

What I claim as my invention is—

1. In a system of electric communication to and from a moving railway car or vehicle, a conductor parallel with the path of the vehicle, in combination with means carried upon the car in close proximity to said conductor and in closed electric circuit for producing an electric current through inductive action upon said conductor on the principle of magnetic or current induction.

2. In a system of railway-signaling in which signals are transmitted to a moving car, the combination, with a conductor arranged parallel with the way over which the vehicle travels, and in suitable proximity thereto, of

means upon the vehicle in locally-closed circuit for transforming by the principle of induction the signaling-impulses upon the conductor into corresponding electrical impulses in the circuit upon the vehicle.

3. In a system of electrical communication to and from a railway-car, the combination of a conductor parallel with the way over which the car or vehicle travels, and means carried upon the vehicle in suitable proximity to the conductor and on closed circuit whereby the signaling-currents in the conductor may be transferred to the car by inductive action in contradistinction to actual conduction of the signaling-impulses from said conductor to a conductor on the car in electrical connection therewith.

4. In a system of communicating by electricity with a moving railway-car, the combination, with a line-conductor, of one or more coils of wire upon the car, arranged with their axes transverse to the conductor and carried in suitable inductive proximity thereto.

5. In a system of telegraphing to moving railway-cars, the combination, with a line-conductor, of one or more magnet-cores carried upon the car in continuous inductive proximity to the line-conductor, and arranged transversely thereto, and coils of wire upon said magnet-cores, as and for the purpose described.

6. In a system of electrical inter-communication between a fixed station and a railway-vehicle, the combination of a line-conductor, a complete or closed local circuit upon the vehicle, and devices upon the car arranged in suitable proximity to the line-conductor for inducing electric currents in the car-circuit from the line-conductor, or vice versa, inducing currents in the line-conductor from the car-circuit, as and for the purpose described.

7. In a system of communicating by electricity to and from a railway car or vehicle, the combination of a line-conductor, a telephone upon the vehicle, and a closed local circuit containing the telephone, and arranged in suitable proximity and relation to the line-conductor, whereby currents upon the line-conductor may be reproduced by induction in the telephone.

8. In a system of communicating by electricity between a moving railway-car and a fixed station, the combination of a line-conductor, an alternating-current generator, and a receiving-telephone at the fixed station, a telephone upon a moving vehicle, an electro magnet or magnets arranged in close proximity to the line-conductor, and means for producing in the coils of said magnets rapidly-alternating currents.

9. In a system of electrical communication to and from a moving railway-vehicle, the combination of a line-conductor, and means upon a car for causing magnetic lines of force to sweep transversely across said line-conductor.

10. In a system of electric communication between a moving vehicle and a fixed station or other vehicle, an induction apparatus of any desired kind, as described, one element of which consists of a conductor parallel to the way or path in which the vehicle travels, while the other element is carried by the vehicle on closed circuit and in suitable proximity or relation to said conductor, as and for the purpose described.

11. In a system of electric communication to and from a moving vehicle, the combination of a line-conductor, an alternating-current generator on a vehicle, and means upon the vehicle carried in suitable proximity or relation to the conductor and on closed or complete electric circuit whereby said alternating currents may induce alternating currents in the conductor.

12. In a system of electric communication to and from a moving vehicle, the combination of a line-conductor parallel with the way, an alternating-current dynamo for setting up rapidly-alternating currents upon said line, a closed local circuit upon a moving vehicle, and devices carried by said vehicle in suitable proximity or relation to said conductor whereby the rapidly-alternating currents in the latter may induce rapidly-alternating currents in the local circuit.

Signed at New York, in the county of New York and State of New York, this 12th day of March, A. D. 1884.

LUCIUS J. PHELPS.

Witnesses:
THOS. TOOMEY,
GEO. C. COFFIN.