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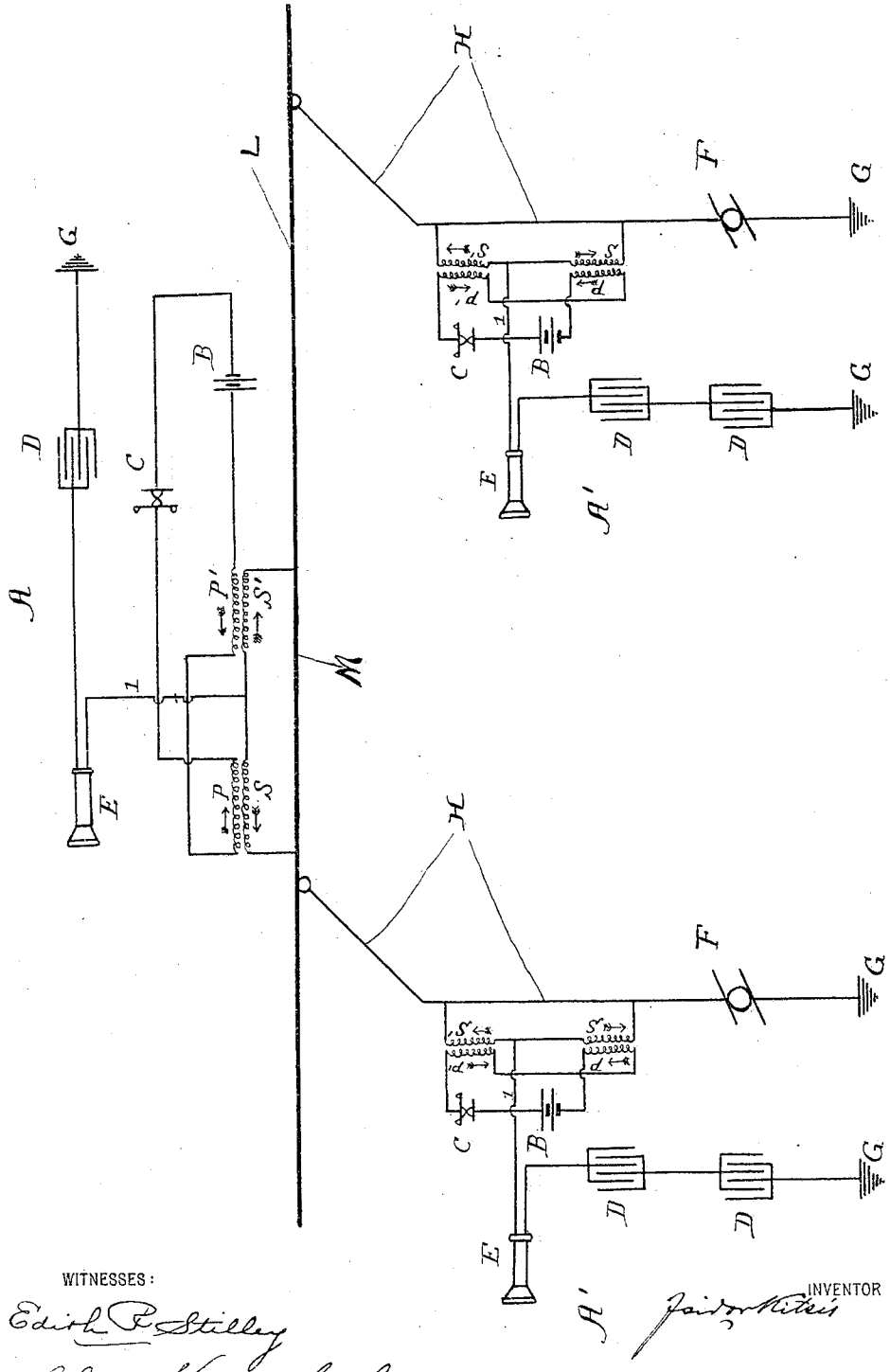
I. KITSEE.

TELEPHONY.

APPLICATION FILED MAR. 13, 1901.

NO MODEL.



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UNITED STATES PATENT OFFICE.

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TELEPHONY.

SPECIFICATION forming part of Letters Patent No. 766,502, dated August 2, 1904.

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To all whom it may concern:

Be it known that I, ISIDOR KITSEE, of the city and county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Telephony, of which the following is a specification.

My invention relates in general to the method of transmitting telephonic messages over line-wires carrying electric currents for other purposes, and has more special reference to telephonic transmission on trolley-lines. Its object is to provide means whereby telephonic messages can be sent from the power-house or other station to cars or other moving vehicles along the line, and vice versa. Its further object is to provide means to enable persons along the trolley-line to telephone to each other without interrupting said line.

It is often of great importance for the officer of an electric road to be in communication with one or the other of the cars along the line of travel, and in different cities—as, for instance, in St. Louis—a telephone-circuit is carried along the line of travel and one insulated part of the trolley-wheel is arranged to make contact with such telephone-line. It is the aim of my invention to dispense with this separate line-wire.

In carrying out my invention two main points have to be considered—first, if the telephonic impulses can be received with the aid of a wire in multiple arc as to the motor, and, second, if the telephonic impulses can be transmitted without inserting any device in the what is commonly called "trolley-line." To ascertain this, I have made a series of experiments, of which the two following clearly demonstrate the principle:

Experiment first. A motor of somewhat less than one horse-power was connected with one terminal to a wire representing the trolley-line and at the other terminal to a wire representing the return or rail. The free terminals of the two wires were connected to the secondary of an inductorium, the primary of which was placed in a telephonic transmitting-circuit. In shunt with the motor was placed a telephonic receiver and connected to it in series two condensers. When speech was transmitted through the microphone the same could be distinctly heard in the receiver, thus demonstrating that the telephonic impulses would in preference flow through the receiver and condensers than through the motor.

Experiment second. The free ends of the two wires were disconnected from the secondary, and a battery consisting of six secondaries was placed in the line, actuating thereby the motor. The secondaries of two inductoriums were connected together in opposition as to each other, and their terminals were connected, as is illustrated in the drawing, to the line-wire, shunting a small part of the same. The primaries of these inductoriums were connected in series as to each other, and in this primary circuit was placed a transmitter and two cells. To a point between the two secondaries a circuit was connected including a receiver and a condenser in series, and the free end of this circuit was connected to the second line, representing the rail. The shunt-circuit, including the receiver and condensers above described, was left undisturbed. When speech was transmitted over the primary-circuit, the same was received at the receiving shunt-circuit without undue interference. If the motor was stopped through the breaking of the circuit in quick succession through the medium of an automatic circuit-breaker placed in the motor-circuit or the brushes alternately and rapidly pressed against and moved away from the commutator, a humming sound and sometimes a click was heard in the receiver; but this did not interfere with the receiving of the speech.

The other experiments were mostly in the same line and do not need to be repeated here.

Referring now to the drawing, which illustrates in a diagrammatic view one stationary station and two moving stations, A represents the former, A′ A′ represent the latter, B is the battery, C the transmitter, P and P′ are the primary coils connected together in opposition as to each other, S S′ are the secondaries, E is the receiver connected through wire 1 to the secondaries, D the condenser, and G the ground or rail. The terminals of the secondaries, which are connected together in series, are connected to the line-wire L at the permanent station; but they are connected to the

wire H at the moving stations. At the moving stations F F are the motors. That part of the line or trolley wire which forms the shunt to which the secondaries S and S′ are connected is designated by M. The length of this part of the line or trolley wire need not exceed a fraction of one inch, and its resistance to the resistance of the two coils is therefore infinitely small, and as no other part of the device is parallel to any part of the line-wire carrying the straight current it is obvious that the line-wire will not produce inductive effects upon any part of the telephone-circuit, and as the condensers D are only transparent to the high-frequency telephonic alternations and not to the slow pulsations due to the variable state of the current in the motor-circuit it is also obvious that the telephonic impulses will be received without undue disturbances.

I will now describe the *modus operandi* of my invention at the stationary station, the moving stations being duplicates thereof. Two inductoriums are connected together in a manner so that the impulses generated in the secondaries, through the variation of the current due to the pressure of the diaphragm in the receiver, are always in opposition to each other. It does not matter if the primaries are oppositely connected and the secondaries in series or if the primaries are in series and the secondaries in opposition. The result will always be the same. The terminals of the secondaries are then connected to the line-wire in a manner as is illustrated in the drawing, shunting the space of the line-wire between the points of connection. When impulses are generated in the secondaries, they will not flow through the short shunt, because these impulses oppose each other; but they will flow over the line-wire in opposite directions. If a car is on the same line, these impulses can be received with the aid of the receiver placed in the car.

It is understood that the current carried by the line-wire in this system must be a direct one, since if the current useful for power and light is an alternating one then the same would travel through the condensers as well as the current set up by the telephonic transmitters. It is also to be understood that the part of the line-wire shunted by the secondary coils should be as short a piece as practice will permit, for the reason that the resistance of the shunted part should be, as compared with the resistance of the coils, practically *nil*.

Through the varying resistance of the transmitter C, due to the transmitted speech, the current-flow in the primaries P P′ will vary, and therefore induced currents will be generated in the secondaries S S′; but as the primaries P P′ are connected so that the direction of the current-flow will be in opposition it is obvious that the induced currents in the secondaries S S′ will also be in opposition. The induced impulses, therefore, will not be able to neutralize each other in the shunt formed of that part of the line to which the secondaries S and S′ are connected; but they will flow over the line in different directions in accordance with the resistance which they will meet in said line or circuits connected thereto and to the ground. Thus if one car is traveling on the right-hand side of the shunt and one car on the left-hand side of the shunt, all other influence being equal, the induced currents will divide in equal proportions, one part flowing to the right and one part flowing to the left.

The path of the induced impulses is as follows: over the line L, through the trolley-wheel and part of its wire H. At that part of the wire H where the secondaries S S′ are connected two paths are open for the induced impulses. One path is through one of the secondaries, the receiver E, condenser D to the ground G. The other path is through the motor F and ground G; but as the motor F acts toward the induced current as a great impedance the selection of the induced impulses will be toward that path in which the condensers D are inserted. It must be said in this connection that even such a small motor as was used in the experiments hereinbefore referred to acted quite sufficient to retard the flow of the induced currents and throw the same into the path containing the receiver. It is therefore obvious that if the motor as used in the experiments is replaced by a motor of from five to twenty horse-power the impedance action of the same will be the greater, and as in electric railways the current from the line L never flows to the ground without the interposition of the motor F it is readily seen that the selective path will always be the one with the receiver and condenser inserted therein.

As to that part of the line which is shunted by the secondaries S S′, the length of this shunt need not be taken into consideration for the reason that, as said above, the simultaneously-generated impulses in S and S′ are opposed to each other; but this shunt must be made electrically part of the line-wire in order to give the impulses a chance to flow in a direction where they do not oppose each other and at the same time make this direction electrically part of the line, so that the trolley may carry the same to the desired destination.

Supposing that the shunt of S S′ should include the greatest part of the line and also supposing that said shunt should include only about, say, one foot, of the line. In both cases no current would flow in the shunt as long as there is any other outlet for said current; but the currents of each secondary will tend to flow toward such parts of the line which are outside the shunt, and if it happens

that to such part of the line a trolley is contacting the impulses will then flow, as said before, to the trolley and its wire and in the greater part through the receiver and condenser to the ground.

It may be asked why a shunt as such is necessary and why an arrangement cannot be used wherein the secondaries S S′ are connected in opposition to each other in a closed circuit connected with one single wire to the line. In answer to this it may be stated that in practice it has been found that it is far better to make part of the line L a shunt than to simply connect the closed circuit through a single wire with the line.

I have not illustrated the method of ringing up the car or stationary station, because this method is well known by persons versed in the art, only it should be borne in mind that to ring up telephonic stations, as illustrated, it is necessary to use a current of a high-tension electromagnetic device, and bells which are actuated by such devices shall be placed in series in the receiving-circuit, and means should be provided to shunt the same, so that they shall not offer undue resistance, because after the ringing up communication through speech should be established.

If it is desired to communicate from the car with any other than the stations in the power-house, then the power-house can be connected through one of the well-known connecting devices with a telephonic exchange.

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

1. The method of transmitting speech over a line-wire carrying a direct current useful for other purposes, which consists in causing alternating-current impulses to be generated in the secondaries of an inductorium connected in shunt as to part of said line-wire, simultaneously through the varying resistance of the transmitter, and of receiving the same with the aid of a receiver electrically connected with the interposition of a condenser or condensers to the ground or return.

2. The method of transmitting speech over a line-wire carrying a direct current useful for other purposes, which consists in simultaneously sending over the line-wire in opposite directions alternating-current impulses generated through the varying resistance of a telephone-transmitter, and receiving the same with the aid of a suitable receiver electrically connected to said line-wire and the ground or return with the interposition of a condenser or condensers.

3. The method of transmitting speech over a line-wire carrying a direct current, which consists in generating oppositely-flowing impulses in the secondaries of a plurality of inductoriums which secondaries are connected in shunt as to the line-wire, establishing an impedance to divert the flow of the impulses, and receiving the diverted impulses by a suitable receiver electrically connected to the line and with the ground or return with the interposition of a condenser.

4. The method of transmitting speech over a line-wire carrying a direct current, which consists in generating oppositely-flowing impulses in the secondaries of a plurality of inductoriums which secondaries are connected in shunt as to the line-wire, causing the impulses generated in one secondary to neutralize the impulses generated in the adjacent secondary, establishing an impedance to divert the flow of the impulses, and receiving the diverted impulses by a suitable receiver electrically connected to the line and with the ground or return with the interposition of a condenser.

In testimony whereof I hereby sign my name, in the presence of two subscribing witnesses, this 12th day of March, A. D. 1901.

ISIDOR KITSEE.

Witnesses:
EDITH R. STILLEY,
CHAS. KRESSENBUCH.