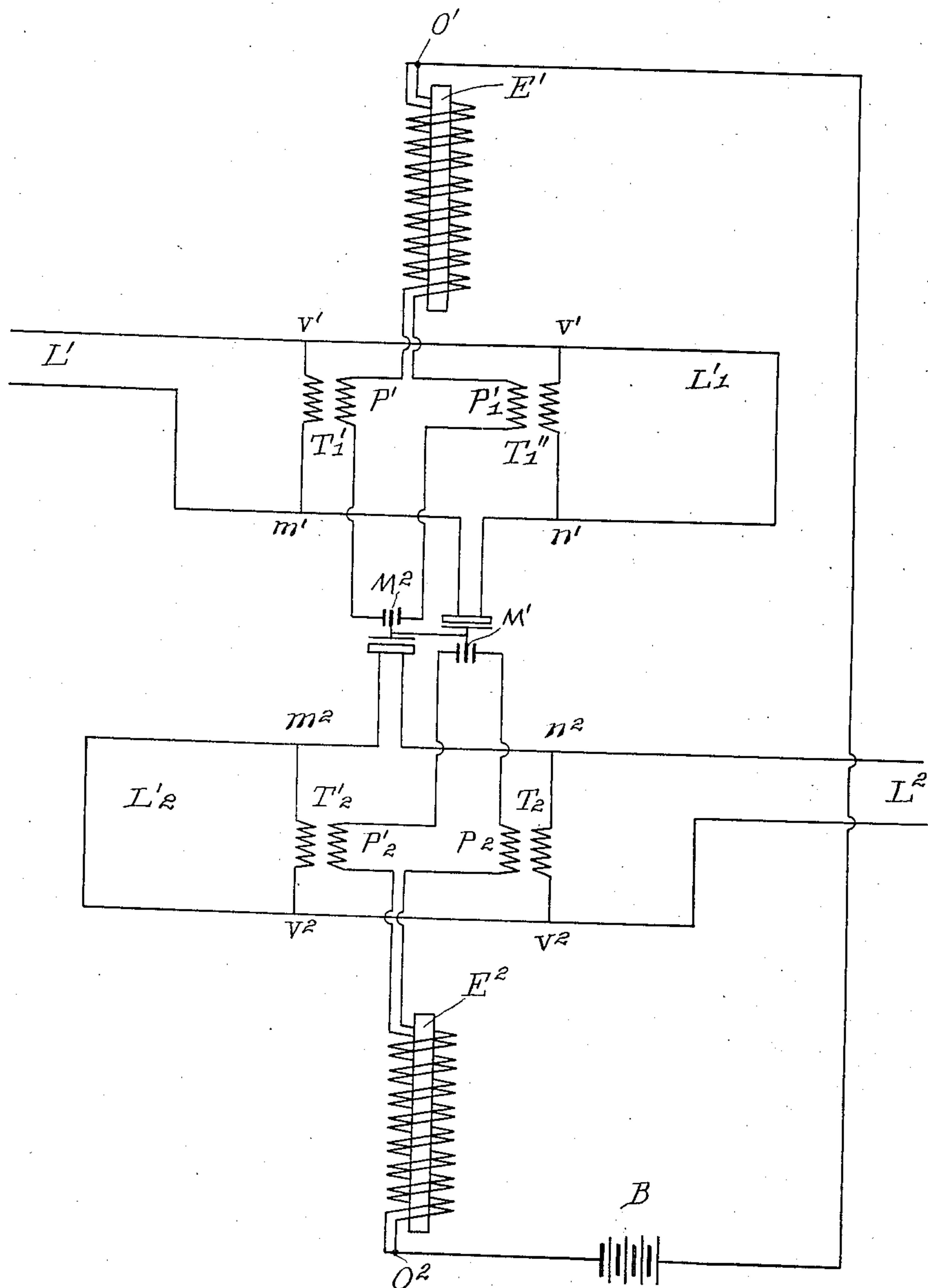


P. STRAGIOTTI.
 TELEPHONE REPEATER.
 APPLICATION FILED AUG. 11, 1908.

958,560.

Patented May 17, 1910.



Witnesses

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TELEPHONE-REPEATER.

958,560.

Specification of Letters Patent. Patented May 17, 1910.

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To all whom it may concern:

Be it known that I, PIETRO STRAGIOTTI, subject of the King of Italy, residing at Hurley, in the county of Iron and State of Wisconsin, have invented certain new and useful Improvements in Telephone-Repeaters; and I do 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 appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to the class of telephony and consists in a combination of electrical connections employed in such manner that by the use of two repeaters in an intermediate station with the two parts of a line having only two wires (one of which wires may be surrogated to the ground) it is possible to obtain so far as the telephonic communication is concerned a perfect continuity of said line avoiding any trouble of backward interference from the repeaters.

In the drawing the figure represents the wiring.

Each of said two parts of the telephonic line has control of only one repeater; while each repeater has control of only one of said two parts of the telephonic line.

As this invention consists essentially in its electric connections the drawing is only diagrammatic to the end of clearly showing the circuits, but in the following specification will be given all necessary details, therefore making the invention entirely clear.

The electric connections are represented in the figure. In the figure the repeaters are shown only conventionally in M' and M^2 , and it is intended that the wires that go from repeater M' to the points m' and n' connect the coils of this repeater with the telephone circuit L' ; while the wires which go from other points of said repeater to the coils P^2 and P' , connect to said coils the outside electrodes of the differential microphone pertaining to apparatus M' and the wire which connects repeater M' to repeater M^2 is intended to connect the central electrodes of the differential microphones of each repeater. By the latter connections the differ-

ential microphones are inserted in the local circuit fed by battery B. 55

L' and L^2 are two separate circuits of a telephonic line.

L'_1 and L'_2 are two local circuits, of which circuit L'_1 is made electrically equal (as for the telephonic currents) to circuit L' of the telephonic line, while circuit L'_2 is made in the same way equal to circuit L^2 . To obtain such electrical equality it is intended to establish a local circuit the same as the line circuit by dividing this local circuit in sections, each to correspond to a line section and having same resistance, same capacity and same inductance as the corresponding line sections. With two sections good results are already obtained; but the end is reached easier if the telephonic line contains some induction coils, dividing it effectively in sections, as it is of great use in the telephonic lines to avoid side tone from too long sections. In this instance the section contiguous to the station where the repeater is can be made with such ohmic resistance that the inductance and capacity of that tract become of secondary importance. Then to establish a similar circuit only this contiguous section is to be considered, the following sections becoming of so little importance that only an appropriate inductance is required to cover the balance. 60 65 70 75 80

Circuit L' and circuit L'_1 are connected by connection $v'-v'$ and by conductor $m'-n'$ which passes through the coils of repeater M' . 85

Circuit L^2 and L'_2 are connected by connection v^2-v^2 and by conductor m^2-n^2 which constitutes the coils of repeater M^2 . The two transformers T'_1 and T''_1 , the secondary coils of which are exactly alike have respectively secondary coil of T'_1 inserted between v' and m' and secondary coil of T''_1 inserted between v' and n' . 90 95

The two transformers T_2 and T'_2 , the secondary coils of which are exactly alike, have respectively secondary coil of T_2 inserted between v^2 and n^2 , and secondary coil of T'_2 inserted between v^2 and m^2 . In this manner there are established two triangle connections; one triangle having two sides made by the secondary coils of transformers T'_1 and T''_1 , while the third side is made by the coil (or coils) of repeater M' ; and the 100 105

other triangle having two sides made by the secondary coils of transformers T_2 and T'_2 and the third side by the coil of repeater M^2 .

The transformers T'_1 and T''_1 have identical secondary coils and identical iron cores, but differ in the winding of the primary coils, in such manner as to have equal but opposite action on the respective secondary. In the same way, transformers T_2 and T'_2 are identical in everything but the winding of the primary coils; or which amounts to the same thing, are identical in everything except the connections of the primary coils which are inverted with respect to each other.

E' and E^2 are two double impedance coils. The two coils which constitute the double coil E' or E^2 are wound over a relatively great mass of magnetic material, and the winding being in the same direction they act upon each other in such a manner as to allow only variations opposite and alike in the flowing current, as can be expected from the magnetization of the core reacting to any sudden change. But to permit opposite and alike variations of the flowing currents as well as to maintain constant the total current, this double coil acts as an impedance coil.

The local constant current produced by the battery B forks through the impedance coils E^2 to pass through the two primaries of the transformers T_2 and T'_2 and join at the central electrode of the microphone of repeater M' , thence the current passes to the central electrode of repeater M^2 where it forks and going through the primaries T'_1 and T''_1 and the two windings of E' join again in o' to return to the battery B.

In this application it is not thought necessary to enter into full details about the construction and working of the micro-translator or repeater being too long a digression, as it seems sufficient for the specific purpose of the electric connections here described, to say that a repeater having its coils inserted in a telephonic circuit produces, in consequence of the oscillatory currents there flowing, differential changes of resistance in the differential microphone connected to its vibrating diaphragm, and therefore differential changes in the resistance of the two derived circuits which are formed within said differential microphone.

Such changes as influenced by telephonic currents are so sudden and the reactance of the impedance coils E' and E^2 so strong that the constant current of the local circuit remains uniform and independent of any interference from the microphone if there be any. So each microphone of the repeaters can act only on the two derived circuits which are formed there and becomes in its effect absolutely differential; in other words equal and opposite variations of current are produced in the two primaries inserted in

these derived circuits, and owing to their opposite winding identical induction forces are produced in the secondaries.

To follow the working of the connections, suppose the telephonic current comes from line L' . As this current reaches the points v' m' three derived circuits are offered to it; one through a secondary coil from v' to m' ; the second through the repeater coil and the other secondary coil from n' to v' ; the third again through the repeater coil and the local circuit L'_1 . Therefore if the resistance of the coils of the repeater is smaller than that of the secondary coils a great part of the current from the line will pass through the coils of the repeater M' influencing its microphone which acts therefore as to change differentially the constant current between the two derived circuits that join there. So two identical induction forces are produced in the secondary coils of the two transformers T_2 and T'_2 . By the exact electrical symmetry of the two sides $v^2 m^2$ and $v^2 n^2$ and their connections to the local circuit L'_2 and the line circuit L^2 it follows that the third side of the triangle, namely $m^2 n^2$ will constantly be in electrical equilibrium as long as in the other two sides are originated oscillatory induction forces equal and in the same exact phase as is the case. It follows also, that independently from that equilibrium two telephonic currents are flowing, one in the telephonic line L^2 and the other in the local circuit L'_2 exactly alike in intensity and phase. There- generated by each of the secondary coils and exactly alike in intensity and phase. Therefore, by these connections a telephonic current from line L' will be transferred by repeater M' on line L^2 with greater energy but without any interference with repeater M^2 , and therefore without any effect backward. So the sound wave passes with perfect clearness and is enhanced by the repeater effect. The same will happen from line L^2 to line L' .

In this invention the most important part lies in the electrical connections and in the exact similarity of the two sides of the electrical triangle which comprises the secondary coils of the transformers. To obtain such exactness there may be some difficulty arising from the fact of having two distinct cores, the effect of which cannot so easily be equalized. Therefore instead of two distinct cores for the two transformers T'_1 and T'_2 only one core may be employed. In this instance two identical secondary coils are wound on the common core and two opposite primary coils are wound on the same core. The electrical connections remain the same, and so the figure which is only diagrammatic of electric connections illustrates this case also, but as the two primaries act together on this common core the action on the

secondaries will be more correctly equal, as any troubling influence acting from any inequality of the primaries or from two distinct cores would be avoided.

5 Having thus fully described my invention what I claim as new and desire to secure by Letters Patent of the United States, is:—

10 1. In a telephone repeating station the combination with the electrical triangle connections, of the coil of a repeater inserted in one side thereof, and two identical secondary induction coils inserted in the other sides.

15 2. In a telephone repeating device the combination with the electrical triangle connections, of the coil of a repeater inserted in one side thereof, two identical secondary induction coils inserted in the other two sides, a telephonic line connected to the ends of one of the secondary coils, and a local circuit 20 connected to the ends of the other secondary coil.

25 3. In a telephone repeating station the combination with the electrical triangle connections, of the coil of a repeater inserted in one side thereof, two identical secondary induction coils inserted in the other two sides, a telephonic line connected to the ends of one of the secondary coils, a local circuit 30 connected to the ends of the other secondary coil, a similar electrical triangle, a second telephonic line and the coil of a second repeater connected to said similar electrical triangle, and a local circuit, a source of current therefor, said local circuit forking at 35 the microphone of the first mentioned repeater to flow through two derived circuits, primary induction coils establishing said circuits, said primary induction coils acting 40 on the secondary induction coils of the second mentioned electrical triangle.

4. The combination of two repeaters, a coil for each, each coil being inserted in the side of an electrical triangle connection, two

identical secondary induction coils inserted 45 in the other two sides of the electrical triangle connection, a circuit of a telephonic line connected to the ends of one of said secondary coils, a local circuit connected to the ends of the other, a local circuit, a source of 50 current therefor, by means of which one repeater can act upon the circuit of the telephonic line connected with the other repeater in such manner as not to interfere 55 with the last mentioned repeater.

5. In a telephonic system, the combination of a circuit of a telephonic line with another circuit by means of two repeaters, an electrical triangle connection in the side of 60 which is inserted the coil of a repeater, two identical secondary induction coils inserted in the other two sides, one circuit of the telephonic line being connected to the ends of one of said secondary coils, and means by 65 which one telephone circuit can act through one of the repeaters on the other telephone circuit without interference on the other repeater.

6. A telephonic combination comprising the electrical triangle connections, a repeater, the coil of which is inserted in one 70 side of the triangle connections, two identical secondary induction coils inserted in the other two sides, a magnetic core upon which the two secondary coils are established, and a local circuit, a source of current therefor, a second repeater, said second 75 repeater acting by means of said local circuit, and two opposite coils wound on said magnetic core equally on the two secondary 80 induction coils without interference upon the coil of the first repeater.

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

PIETRO STRAGIOTTI.

Witnesses:

C. M. FORREST,
C. HUGH DUFFEY.