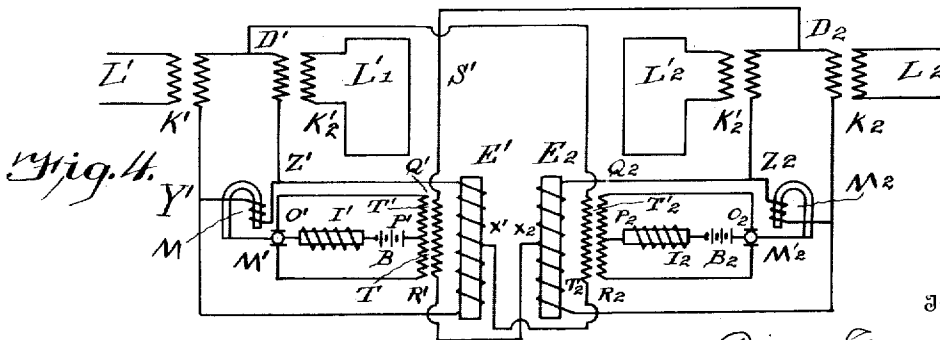
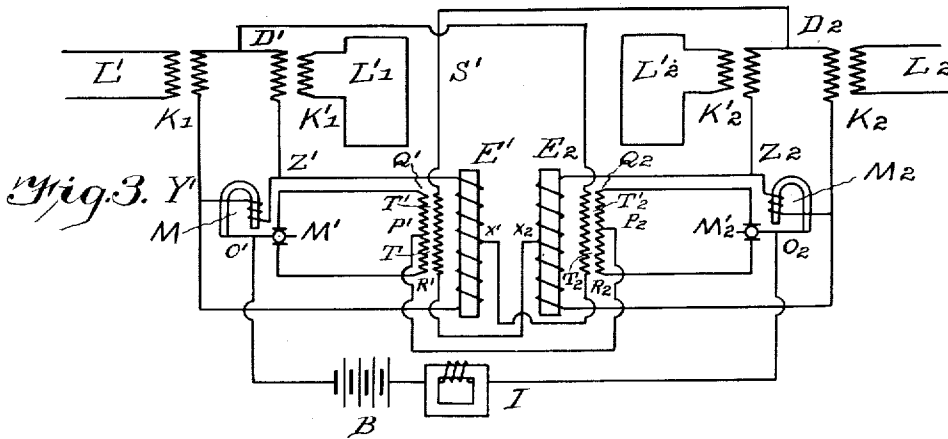
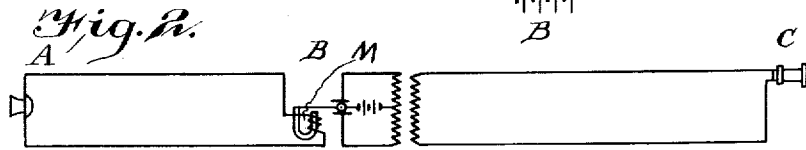
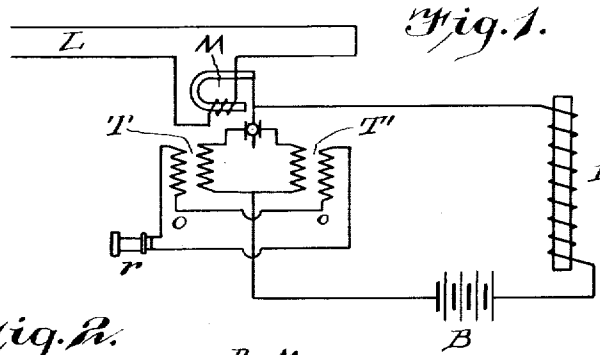


P. STRAGIOTTI.  
TELEPHONE REPEATER.  
APPLICATION FILED AUG. 11, 1908.

954,402.

Patented Apr. 5, 1910.



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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-REPEATER.

954,402.

Specification of Letters Patent.

Patented Apr. 5, 1910.

Application filed August 11, 1908. Serial No. 448,023.

*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 the system of connection of two micro-translators at an intermediate station with the two parts of a line with only two wires (one of the wires may be surrogated by the ground) so that every micro-translator has control of only one line; that is to say that the division of the current generated by one micro-translator is obtained in two parts always equal, so that the two points where the other micro-translator is bridged there is always electric equilibrium.

My invention further consists in certain other novel details of construction and in combinations of parts, all of which will be first fully described and afterward specifically pointed out in the appended claims.

Referring to the accompanying drawing: Figures 1, 2, 3 and 4 illustrate specific systems of wiring.

Like characters of reference indicate the same parts throughout the several figures in which:

I indicates the inductive reactance which is a very material part of the system and by which the differential micro-phone reaches a very great sensibility and energy and becomes more efficient. The inductive reactance consists of a reactance coil in which the current produces a very strong field of self-induction, so that the said current cannot undergo any sudden sensible variation of its medium value.

B indicates the battery and M is the micro-receiver and T and T' are the two transformers, reference being had to Fig. 1. The current coming from the battery passes through the inductive reactance, goes to the central electrode of the micro-receiver where

it forks, each branch passing through the primary of the transformer. As the two transformers are equal, so result two identical derived circuits. The secondaries are connected at the same end  $o-o$  and in this way result in series, therefore to any induction in the same direction on the two primaries, induction forces in the opposite direction correspond on the secondaries, so that to the equal increasing or diminishing of the current in the two primaries the secondary induction current becomes zero, but when under the influence of the micro-receiver M the comparative relation of the two primary currents varies by the increasing of the one and the equal contemporary diminishing of the other (which must happen under the effect of an inductive reactance of sufficient energy) then there are induction forces in the secondary which sum together, and a current is produced in the said secondary proportioned to the variation of the difference which is forming between the two primary currents.

Only one transformer may be used instead of two with its primaries in opposite winding, so that they are neutralized under equal currents; but two distinct transformers are preferable, because when distinct the iron is always magnetized in the same direction; consequently the magnetic permeability is more nearly constant allowing a more correct transmission of the wave to the secondary. The oscillating current which passes in the line L makes the diaphragm of the micro-receiver or micro-translator vibrate, producing a differential variation of resistances in the two parts of the micro-phone, and the production of new oscillating currents in the secondary circuit of the transformers will be the final effect, the said currents being entirely analogous to the currents coming from the circuit L, but much more energetic. Therefore if the said secondary circuit passes through a usual receiver a very feeble telephonic currents may be heard with this disposition, providing they are sufficiently energetic to make the diaphragm of the micro-receiver vibrate. When an oscillatory current is flowing through the coil the action is to change differentially the pressure between the middle electrode and the other two. The changes of resistance in the two derived cir-

cuits which fork at the microphone being differential such will be the variations of the flowing currents, and differential will be the variations of these currents. If these changes of resistance do not exactly compensate each other then the balance acts as to make the main current oscillate while it is intended to remain constant. Therefore the auto-induction coil by opposing such oscillations of the main current acts in a manner that the microphone acts strictly as differential. Now the two transformers being alike, it is clear that when in the primary coils the current is undergoing differential changes, viz., increasing in the one while diminishing in the other e. m. f. of induction are produced in the secondary coils, alike but opposite. But establishing the connections of the secondary coils as those are in Fig. 1 these same e. m. f. sum together and oscillatory current flows therefore in the secondary circuit. In the drawing it is supposed that the two transformers are alike. While it is pointed out in a direct way that the connection of one of the secondary coils is the inverse yet it is clear that the same result can be obtained by changing the direction of the winding of one coil without inversion of any connection.

Referring now to Fig. 2 we will consider that B is the farthestmost station from A where it is possible to hear clearly. If at B a micro-receiver is placed, which in this instance I term a micro-translator, new electric oscillatory currents with the same energy as the original current in A are produced and are therefore able to reach C, said new electric oscillatory currents being produced in the new line from B to C. More than one of the translators can be inserted, and thereby the length of the telephonic line will be very much increased according to the number of translators employed. To be certain of the correct action, two separated lines are needed, namely, one carrying the voice from A to C with translation in B where the micro-translator is under the influence of the line A—B, while the connected transformers command the line B—C, and another independent line which carries the voice from C to A with a special micro-translator in B under the influence of the line B—C and commanding the second line B—A.

A special disposition of the electric circuits has been found (Fig. 4) by which the passing of the telephonic currents indifferently in both directions is obtained with only two wires without the danger that a current coming, for instance, from the first line and transferred to the second may by the micro-translator under the command of the second line act again on the first line causing electric oscillations able to interfere with the proper ones. In this figure  $L'$  and

$L^2$  are the two branches of the line which end at the station where the micro-translators are placed.  $M$  and  $M^2$  are the two micro-translators respectively under the influence of the line  $L'$  and of the line  $L^2$ . In  $O', I', B', P', Q'$  or  $R'$  and  $O'$  there is the local circuit through the micro-phone  $M'$ , the battery  $B'$ , the inductive reactance  $I'$  and the two transformers  $T$  and  $T'$ . In  $O^2, I^2, B^2, P^2, Q^2$  or  $R^2$  and  $O^2$  there is a local circuit through the micro-phone of  $M^2$ , the battery  $B^2$ , the inductive reactance  $I^2$  and the two transformers  $T^2$  and  $T'^2$ . Instead of the two batteries  $B'$  and  $B^2$  and the two reactance coils  $I'$  and  $I^2$  only one battery  $B$  and one reactance coil  $I$  of sufficient energy may be employed, suppressing the circuits  $O', I', B'$  and  $P'$  and  $O^2, I^2, B^2$  and  $P^2$  and using instead the circuits indicated by dotted lines from  $O^2$  through  $I, B$  to  $O'$  and from  $P^2$  through the dotted line to  $P'$  by which the same effect will be obtained. The lines  $L'$  and  $L^2$  lead to the two transformers  $K_1$  and  $K_2$ . The transformer  $K^1$  is exactly equal to the transformer  $K_1$  and the transformer  $K_2$  is exactly equal to the transformer  $K^2$ ; and as for the circuit  $L^1$  the same resistance, capacity and induction, respectively of the line  $L'$ , and as for the circuit  $L^2$  the same resistance, capacity and induction respectively of the line  $L^2$  will be obtained so the circuit  $L^2$  is a circuit equal to  $L_2$ .  $E'$  and  $E_2$  are two double induction coils which undergo such a reactance that any electric oscillatory current passing through them and coming from the points  $\alpha'$  and  $\alpha^2$  at the middle of each double coil must divide in two equal parts as for the phase and intensity, because the self induction of the one coil is suppressed by the induction of the other.

The micro-translators are bridges between the two ends  $Y'$  and  $Z'$  and  $Y^2$  and  $Z^2$  of  $E'$  and  $E^2$ . If there is any oscillatory current on the line  $L'$  the said current will produce another oscillatory current in the micro-translator circuit  $M, Y', D'$  and  $Z'$  so that the micro-phone  $M'$  is working and will produce an oscillatory current of much greater energy in the secondary  $S'$ . The said current will divide at  $\alpha^2$  into two equal parts in intensity and of the same phase in the two circuits  $X^2, Z^2, D^2$  and  $X^2, Y^2, D^2$  to join in  $D^2$ , and two oscillatory currents equal in phase and in intensity will be produced in the two circuits  $L^2$  and  $L'^2$  by means of the transformers  $K^2$  and  $K'^2$ . As to the two currents circulating in the two branches  $X^2, Z^2, D^2$  and  $X^2, Y^2, D^2$  are equal and acting exactly in the same way on the two parts because they are alike in everything, acting forces, and work done the two parts  $Y^2$  and  $Z^2$  on which the micro-phone  $M'$  is bridged will always be under the same tension. Therefore no current coming from the mi-

cro-phone  $M'$  can circulate between the said two points so that the micro-phone  $M^2$  will be silent and will not disturb in any way the acting of the micro-phone  $M'$  by sending  
 5 currents to the line  $L'$ . With this disposition currents coming from the line  $L'$  will pass without any interference to the line  $L^2$  in the same way the currents coming from  
 10  $M^2$  currents on the line  $L'$  acting in the same way.

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

15 1. A repeater circuit which divides in two parallel circuits, comprising the primaries of two transformers and two inductance coils established opposite on the same core, a second repeater having its coil bridged  
 20 between two corresponding points of said parallel circuits.

2. A repeater circuit which divides in two parallel circuits comprising two inductance coils established opposite on the same core,  
 25 a second repeater having its coil bridged between two corresponding points of said parallel circuits.

3. A repeater circuit which divides into two parallel circuits comprising two inductance coils established opposite on the same core, a second repeater which has the coil bridged between two corresponding points of said parallel circuits, a local circuit through an induction coil, a source of  
 30 current therefor by means of which the first repeater can act on a telephone line connected with one of the two parallel circuits

without interference upon the second repeater.

4. In a telephonic system the combination 40 of two telephone circuits, two repeaters therefor, an intermediate local circuit, a source of current therefor, a special circuit on which each repeater acts by means of said intermediate local circuit, said special circuit dividing in two parallel circuits comprising two inductance coils established opposite on the same core, the coil of the second repeater being bridged between two corresponding points of said parallel circuits, one of which is connected with one of said telephone circuits, and means to exactly balance the other of said two parallel circuits so that the circuit of the telephonic line which acts upon the first repeater acts 55 upon the other circuit of the telephonic line without any interference with said second repeater.

5. The combination of two repeaters, each acting on a circuit which divides in two 60 parallel circuits comprising two inductance coils established opposite on the same core, the coil of one repeater being bridged between two corresponding points of said parallel circuits, a local circuit, a source of 65 current therefor by means of which the one repeater acts equally on the said two parallel circuits.

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

PIETRO STRAGIOTTI.

Witnesses:

C. M. FORREST,  
 C. HUGH DUFFY.