No. 778,322. PATENTED DEC. 27, 1904.

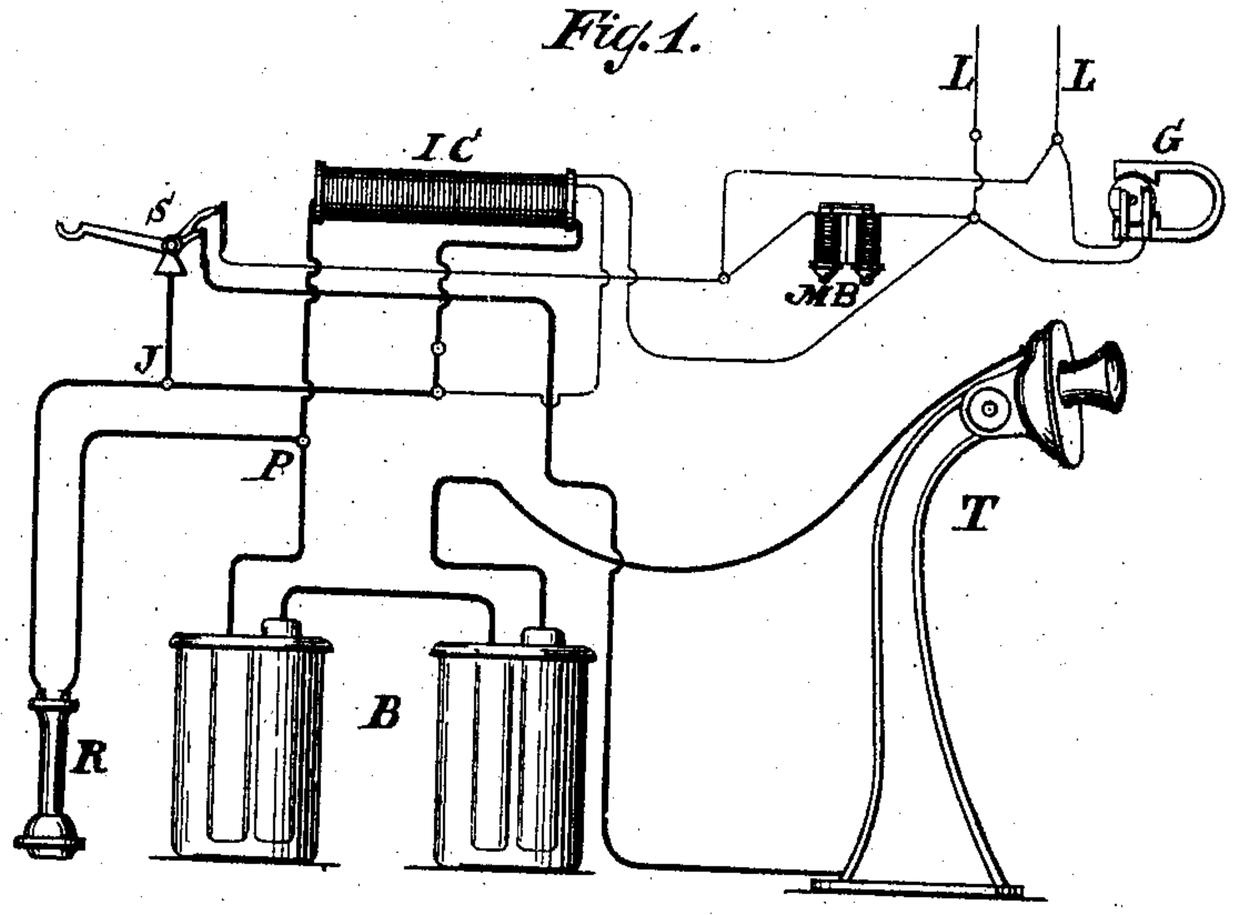
J. W. H. MACLAGAN.

TELEPHONE CIRCUIT.

APPLICATION FILED JUNE 23, 1900.

2 SHEETS—SHEET 1.

Fig. 1.



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No. 778,322. PATENTED DEC. 27, 1904.

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2 SHEETS—SHEET 2.

Fig. 2.

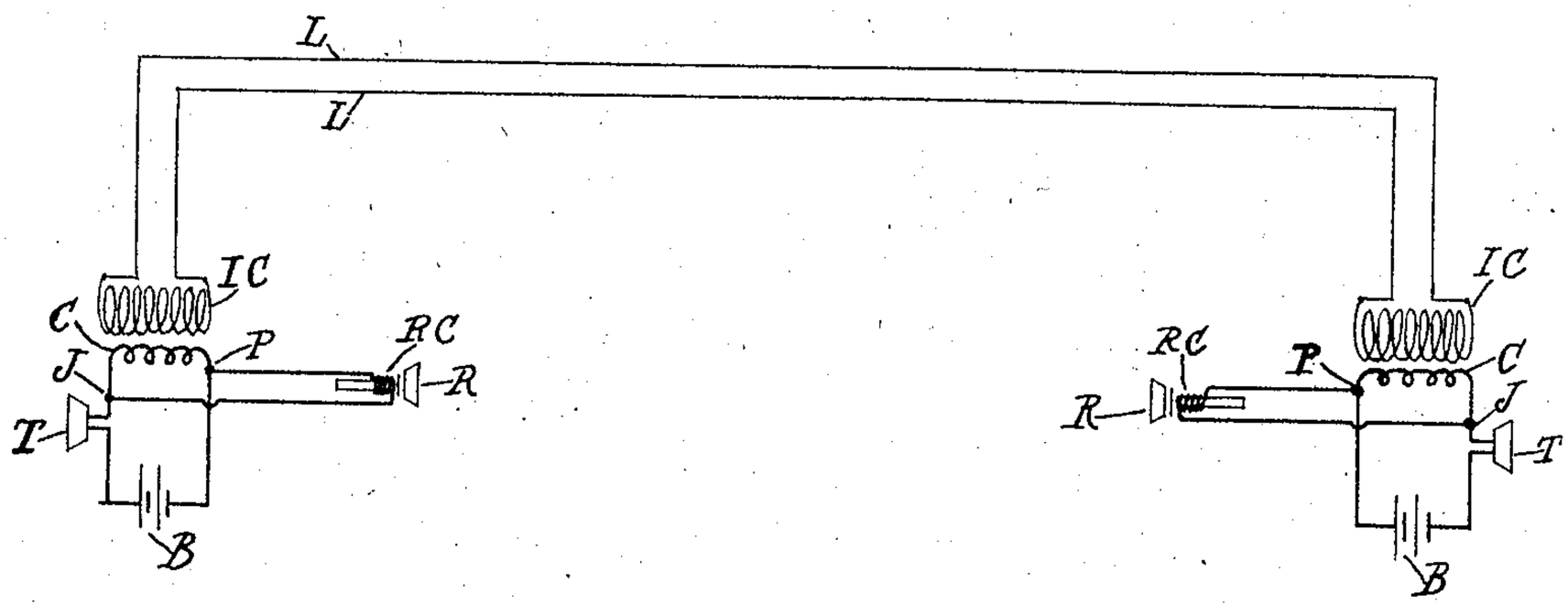
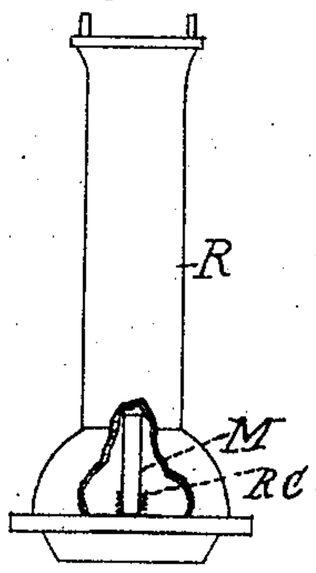


Fig. 3.



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No. 778,322. Patented December 27, 1904.

UNITED STATES PATENT OFFICE.

JOHN W. H. MACLAGAN, OF PARKRIDGE, NEW JERSEY.

TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 778,322, dated December 27, 1904.

Application filed June 23, 1900. Serial No. 21,274.

To all whom it may concern:

Be it known that I, JOHN W. H. MACLAGAN, a citizen of the United States, and a resident of Parkridge, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Telephone-Circuits, of which the following is a specification.

This invention relates chiefly to telephone-circuits; and its principal object is to increase the efficiency of the apparatus and also materially reduce the cost thereof. I cut down the resistance of the line by eliminating the high-resistance receiver-coils usually included in series therein and also make the receiver more efficient and satisfactory in operation and more durable.

In the accompanying drawings, Figure 1 represents the preferred form of receiving-circuit. Fig. 2 is a diagram representing a complete telephone-line between two stations, but omitting bells, switches, &c. Fig. 3 is a view, partly broken away, of an improved receiver.

In the several views similar characters of reference designate similar parts.

At Fig. 1, B represents a battery; T, a transmitter; R, a receiver; IC, an induction-coil; S, a switch; G, a generator; MB, magneto-bells, and LL a line. The primary circuit is shown in heavier lines than the secondary circuit or line. C indicates the primary of the induction-coil, said primary being included in the transmitter-circuit and having low resistance, varying generally from one-half to six and one-half ohms. RC indicates a low-wound receiver-coil having the same or approximately the same resistance as the primary coil C. In practice if the resistance of C equals one-half ohm I make RC equal one-half ohm, or if C is equal to six ohms I make RC equal to six ohms. This proportion may, however, be varied somewhat within the limits of my invention when both C and RC are low-wound. The higher the resistance the less should be the proportionate discrepancy.

At Fig. 2, RC is indicated diagrammatically as having the same number of coils as C; but this is not essential so long as the resistance of the two coils is approximately equal or so long as they are both wound for a low resistance.

At Fig. 3 the receiver-coil is shown as consisting of turns of wire around the effective end of a magnet M. The number of turns in the receiver-coil RC may vary within the scope of the invention, depending upon thickness of the wire and other circumstances, it being desirable, however, to have the same resistance as in the primary coil C.

The magnet M is preferably a soft-iron core, the length thereof being, say, two inches, and the diameter, say, three-sixteenths of an inch. The soft-iron core may be used instead of a permanent magnet.

When the receiver R is removed from the switch, the transmitter-circuit, as usual, is closed and the current flows through the primary coil C, variations being produced in the strength of the current by the usual means when sound enters the transmitter and corresponding currents being induced in the secondary coil IC, which is included in the line LL.

The induced currents traverse the line and at the other station pass through the coil IC, this being the same coil that serves as a secondary when speech is transmitted. In receiving, however, said coil IC serves the function of a primary and affects the current flowing in the adjacent low-wound coil C. This current, it will be understood, is generated by the battery B and in flowing around the primary circuit divides at P, flowing equally through the coils C and RC, the latter being in a shunt around the former. Thus the rise and fall of the currents received by IC affect the strength of the current which is flowing through C and correspondingly affect the flow of the current through RC, thereby varying the magnetism of the magnet M in such a manner as to cause vibrations of the usual receiver-diaphragm. The receiver is thus operated by an inductive action of the coil IC in the line-wire, and by making the two coils C and RC of equal resistance satisfactory results are obtained. I therefore put into successful operation a telephone-receiver arranged in the transmitter-circuit, the gist of

this portion of my invention residing in connecting a low-wound primary coil and a low-wound receiver-coil in a transmitter-circuit, the receiving-coil being preferably in a shunt around the primary coil and the resistance of the coils being by preference approximately equal. By having the receiver-coil low-wound and included in the transmitter-circuit with the usual low-wound primary coil, the battery-current (or a current from any suitable source) is enabled to flow readily through the receiver-coil, so that variations in the strength of such current affect the diaphragm accordingly.

The resistance of the receiving-coil RC should not be much, if any, below that of the primary coil C, as otherwise the latter would be deprived of a proper quantity of the battery-current, the latter short-circuiting through RC; but by having them of substantially equal resistance the coil C is enabled to operate satisfactorily with the current from the cell or battery usually employed, while during the receiving operation the variations in the strength of the portion of the current passing through C cause corresponding variations in the portion flowing through RC, and hence the resistance of the latter should not be such as to cause the current to short-circuit through C, because RC would then fail to be duly operated by the induced currents, and hence would not render acceptable service. For these reasons it will be seen that a receiver of the type which has been in common use for some twenty-four years, in which the resistance is wound as high as possible, using the finest wire made for the purpose of obtaining the best results, such resistance being from seventy to eighty ohms, would not prove acceptable if connected in a primary circuit with a primary coil C wound for a low resistance—that is, with a primary of the resistance that has been in universal use during the same period—viz., from one-half ohm to six and one-half ohms.

In using my invention the sounds heard in the receiver are not only strong, but remarkably clear, while the difficulties experienced in the ordinary telephone by reason of loud talking into the transmitter are entirely avoided. Various attempts have heretofore been made to minimize the evil effects produced by loud talking, and it has been found necessary to caution the user of the ordinary telephone to observe various directions as to modulation of voice, distinctness of utterance, distance of the mouth from the transmitter, &c.; but in my apparatus loud talking produces no ill effects, and the sender is easily understood. In practice I have found that speech which is unintelligible in the ordinary receiver connected in the usual manner is perfectly clear when my apparatus is employed. Moreover, the sharp and disagreeable noises produced in the receiver of the ordinary apparatus during the usual manipulation of making connections, &c., are avoided or at least so reduced as to be unappreciable.

It will be observed that I have not only improved the qualities of the apparatus, but also that by eliminating from the line the two receiver-coils I reduce the resistance of the line about one hundred and fifty ohms, which is a desideratum. This elimination is of especial value where several subscribers are connected upon a single line. Heretofore the number of subscribers that could be placed upon one line has been limited, owing to the reaction of the currents upon a number of cores or to the extra currents produced thereby, the aggregate effect thereof being sufficient to render conversation unintelligible when three or four subscribers were connected upon one line; but by my invention this difficulty is greatly reduced, so that many more subscribers can be connected upon a single line, thus rendering the invention of great utility in this particular field, as well as in general service.

One important feature of my improvements resides in substituting for a permanent magnet of large size a small magnet M, which is exceedingly sensitive and rapid in action, thus materially improving the efficiency of the apparatus, as well as reducing the initial cost thereof. Instead of depending upon the size of the magnet for preserving its efficiency I depend upon the magnetizing effect of the current flowing in the transmitter-circuit, whereby the magnetism is constantly produced or renewed, as explained, and it will be understood in this connection that my invention has a twofold advantage in that I utilize the current in the transmitting-circuit for renewing the magnetism of a small and sensitive magnet and also in that by using a low winding for the magnet I am enabled to place all the coils of wire effectively within the field of force, thus improving the efficiency of the telephone, whereas in the usual telephone only about two-thirds of the coil can be so placed.

My improvements are particularly valuable in short telephone-circuits, such as used in office-buildings and other establishments, in which simple loose contact-transmitters can be used having induction-coils of only one-half ohm primary and one-half ohm secondary, with short cores, and using only a single Leclanché cell to operate the transmitter.

I claim as my invention—

1. In a telephonic apparatus, the combination of a line-circuit; a secondary coil at each end of the line, said coils being connected in series with said circuit; a transmitting-circuit at each end of the line including a low-wound primary coil; and a low-wound coil forming part of a receiver at each end of the line and in a shunt around the primary coil in the transmitting-circuit; there being substantial

equality between the resistance of the primary and the resistance of the receiver coils.

2. In a telephonic apparatus, a transmitting-circuit including a primary coil, a secondary coil connected to the line, and a coil forming part of a receiver and in a shunt around the primary coil in said transmitter-circuit; the resistance of such receiver coil being approximately equal to that of said primary coil.

3. In a telephonic apparatus, the combination of a line-circuit; a secondary coil at each end of the line, said coils being connected in series with said circuit; a transmitting-circuit at each end of the line including a primary coil; and a coil forming part of a receiver at each end of the line and in a shunt around the primary coil in the transmitting-circuit; there being substantial equality between the resistance of the primary and the resistance of the receiver coils, and this resistance varying from a fraction of an ohm to three or four ohms.

4. In a telephonic apparatus, a transmitting-circuit including a low-wound primary coil, a secondary coil connected to the line, and a low-wound coil forming part of a receiver and in a shunt around the primary coil in said transmitter-circuit; the resistance of said receiver-coil being approximately equal to that of said primary coil.

5. In a telephonic apparatus, the combination of a line-circuit; a secondary coil at each end of the line, said coils being connected in series with said circuit; a transmitting-circuit at each end of the line including a primary coil; a coil forming part of a receiver at each end of the line and in a shunt around the primary coil in the transmitting-circuit; and small receiver-magnets for said receiver-coils; said receiver-coils being low-wound, and there being substantial equality between the resistance of the primary and the resistance of the receiver coils.

Signed at New York, in the county of New York and State of New York, this 22d day of June, A. D. 1900.

JOHN W. H. MACLAGAN.

Witnesses:
CHAS. C. GILL,
GUNDER GUNDERSON.