

PATENT SPECIFICATION

407.808

Application Date: Jan. 27, 1933. No. 2661/33.

(Patent of Addition to No. 372,400: dated Feb. 7, 1931.)

Complete Left: Nov. 24, 1933.

Complete Accepted: March 29, 1934.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Telephone Instrument Circuits.

We, SIEMENS BROTHERS & Co. LIMITED, of Caxton House, Tothill Street, Westminster, London, S.W. 1, a Company registered under British Law, and
 5 EDMUND RAMSAY WIGAN, of 18, Cambridge Road, Lee, London, S.E. 12, a British Subject, do hereby declare the nature of this invention to be as follows:—

10 The present invention relates to telephone instrument circuits and more especially to circuits for use with instruments in which a local battery is employed in connection with the trans-
 15 mitter.

In Specification No. 372,400 circuits are shown for reducing side tone in a telephone instrument circuit and a mathematical consideration of the circuit relations is given, and discloses the fact that side tone in an instrument circuit depends to some extent on the line condition obtaining, and not only on the characteristics of the line between the instrument
 20 and the local exchange but also on the characteristics of lines that may be connected thereto for completing a connection.

30 The object of the present invention is to provide similar anti-side tone arrangements for instruments in a local battery system.

In this invention the three winding in-

duction coil and impedances arranged as in the aforementioned specification are employed. The receiver is connected between one line wire and one end of one winding of the induction coil, the other end of the said winding being connected to the other line wire. The transmitter is connected in series with a second winding of the induction coil and the local battery and one end of this series circuit is connected to a point in a circuit, containing an impedance or impedances in series with the third winding of the induction coil and connected in parallel with the receiver circuit, such that there is an impedance or resistance between the point of connection and one end of the receiver circuit. The other end of the transmitter circuit may be connected so as to include in series with the transmitter a part of the impedance in the circuit referred to in parallel with the receiver circuit, or it may be connected to form a closed circuit connected to a point in the said parallel circuit.

Dated this 27th day of January, 1933.

SIEMENS BROTHERS & CO.
LIMITED,

By their Attorney,

F. A. LAWSON,

For Selves & Co-Applicant.

COMPLETE SPECIFICATION.

Improvements in or relating to Telephone Instrument Circuits.

60 We, SIEMENS BROTHERS & Co. LIMITED, of Caxton House, Tothill Street, Westminster, London, S.W. 1, a Company registered under British Law, and
 65 EDMUND RAMSAY WIGAN, of 18, Cambridge Road, Lee, London, S.E. 12, a British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to telephone in-

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strument circuits for telephone systems and more particularly to an improvement or modification of the invention claimed in Specification No. 372,400, the arrangements according to the present invention being especially suitable for instruments in a local battery system.

In specification No. 372,400, instrument circuits embodying three-winding induction coils are shown, the circuits being arranged so that side tone may be readily controlled. A mathematical

consideration of the behaviour of the circuits is given with a view to facilitating design and attention is especially directed to the fact that the extent to which side tone is suppressed in any anti-side tone system or circuit does not depend on the instrument circuit alone but also depends on the line impedance and on the frequency of the currents involved. It is pointed out that in general the line impedance is variable even as regards a particular instrument, since the impedance of the line as seen from the instrument depends not only on the local line (i.e. the line to the exchange) but on any junction or trunk line involved in the connection between subscribers. It is further pointed out that it is not considered that total elimination of side tone is desirable except in the noisiest situations, as the side tone to some extent serves as a guide to the telephone user in regulating the loudness of his speech and the absence of sound in one ear whilst external sound reaches the other is disturbing, giving a feeling of deafness.

The telephone instrument circuit claimed in Specification No. 372,400 is one in which a side tone controlling part comprises two impedances in series, these two impedances forming a branch connected in parallel with the transmitter, and a winding (L1) of the induction coil being included either in this branch or in series with the transmitter. Another winding (L2) of the induction coil is traversed by the whole of the line current, and the third winding (L3) and the receiver are connected in series across one of the said impedances.

In the present invention, a telephone instrument circuit has a side tone controlling part which comprises two impedances in series, these two impedances forming a branch connected in parallel with the receiver, and a winding (L1) of the induction coil being included either in this branch or in series with the receiver. Another winding (L2) of the induction coil is traversed by the whole of the line current, and the third winding (L3) and the transmitter are connected in series in a circuit which is bridged across one of the said impedances.

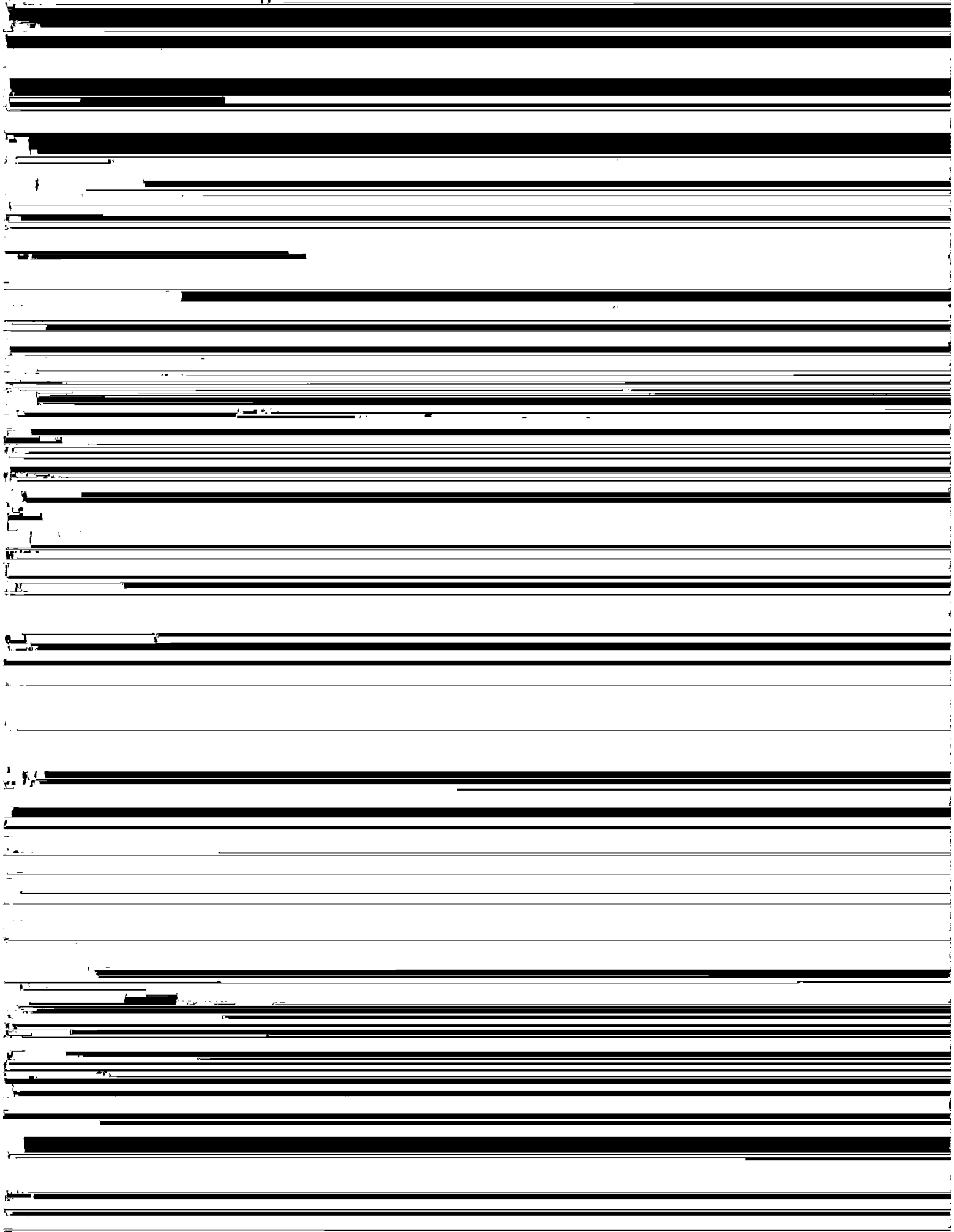
It will be noted that instrument circuits of this character are obtained by interchanging the transmitter and the receiver in the circuits shown in Figs. 5 to 7 of Specification No. 372,400. An important consequence of interchanging the transmitter and receiver in these circuits is that a circuit arrangement is obtained which is readily adaptable to local battery working, as when the interchange is made the transmitter is connected in a

local closed direct-current circuit including the transmitter itself, a winding (L3) of the induction coil, and one of the two impedances (it being assumed that this is of such a character that it will conduct direct current), and the insertion of a comparatively low resistance local battery in this closed circuit does not materially affect the anti-sidetone properties of the instrument circuit as a whole.

Fig. 1 of the accompanying drawing shows one form of telephone instrument circuit according to the present invention, this circuit being derived from Fig. 5 of Specification No. 372,400 by interchanging the transmitter T and receiver R and inserting a local battery LB in the closed circuit referred to. Other elements in Fig. 1 are designated similarly to corresponding elements in Figs. 5 to 7 of the prior specification. The impedance Z must be of such a character that it will conduct direct current, i.e. it must not include a series condenser. Other forms of instrument circuit according to the invention are obtained when the circuits shown in Figs. 6 and 7 of the prior specification are modified in a similar manner.

In general, the mathematical consideration of the behaviour of the circuits of Specification No. 372,400 which is given in that specification still holds when the transmitter and the receiver are interchanged. Care must however be taken in applying the formulæ to use the values of the ratios P/a and K/c and the impedance Z_c appropriate to the changed circuit conditions. Under these changed conditions the expressions "step up" and "step down" used in the prior specification in connection with the two ratios do not necessarily apply. For a given set of components, when the interchange is effected the position of the point Q in the diagram of Fig. 1 of the prior specification remains unaltered and the locus forms remain circular, but the circles may change somewhat in position and diameter depending upon the values of Z_c , P/a and K/c , which as before can be ascertained by direct measurement. As in the circuits of the prior specification, the whole or a part of one or the other of the two series-connected impedances of the side tone controlling part may be included in a winding (L1) of the induction coil by arranging that this winding is a high-resistance winding. By a high-resistance winding is meant one for which the effective resistance per turn is designedly large compared with the effective resistance per turn of the other windings. Similarly, the impedances may where circuit conditions permit include inductance and capacity.

Fig. 2 of the accompanying drawing use in a quiet situation as described



- of the order of $124+j230$ ohms at a frequency of 796 cycles per second. The transmitter has a resistance of the order of 50 ohms.
- 5 Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—
- 10 1. A telephone instrument circuit including a three-winding induction coil, a receiver, a transmitter, and a side tone controlling part comprising two impedances in series, in which a third winding
- 15 (L3) of the induction coil and the transmitter are connected in series in a circuit which is bridged across one of the said impedances, a line winding (L2) of the
- 20 induction coil is traversed by the whole of the line current, and the two impedances form a branch connected in parallel with the receiver whether or not the remaining winding of the coil is included in that branch or in series with the re-
- 25 ceiver, substantially as described.
2. A telephone instrument circuit according to Claim 1 in which a local battery is included in series with the third winding of the induction coil and
- the transmitter, the impedance across 30 which the series circuit is bridged being of such a character that it will conduct direct current.
3. A telephone instrument circuit 35 according to Claim 1 in which a three-conductor cord is used for connecting the transmitter-receiver combination to the remainder of the instrument circuit.
4. A telephone instrument circuit 40 according to Claim 1 which is readily convertible for use in special circumstances (e.g. in quiet situations) terminals being provided to allow of the altering of the wiring or connections so as to short-circuit or remove one of the impedances 45 (Z), substantially as described.
5. A telephone instrument circuit according to Claim 4 which is adapted to be further modified by transposing two 50 of the induction coil windings, substantially as described.

Dated this 24th day of November, 1933.
 SIEMENS BROTHERS & CO.
 LIMITED,
 By their Attorney,
 F. A. LAWSON,
 For Selves and Co-Applicant.

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.

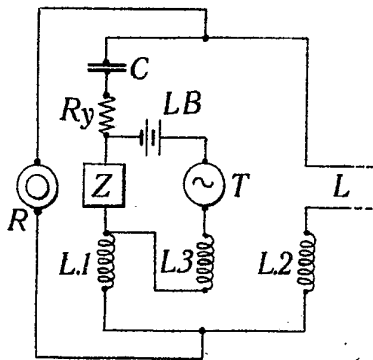


Fig. 3.

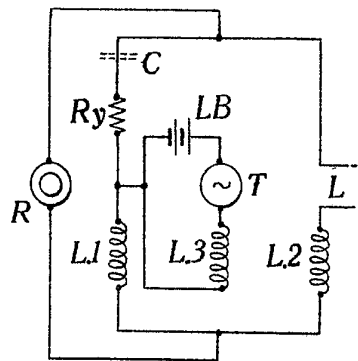


Fig. 2.

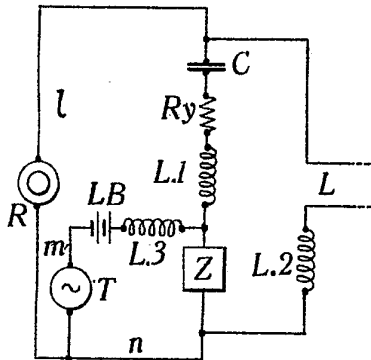


Fig. 4.

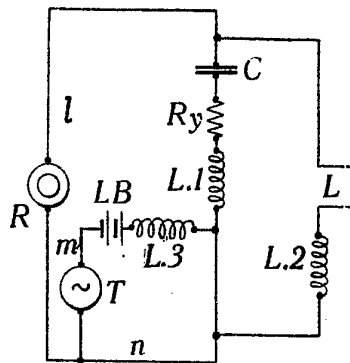


Fig. 5.

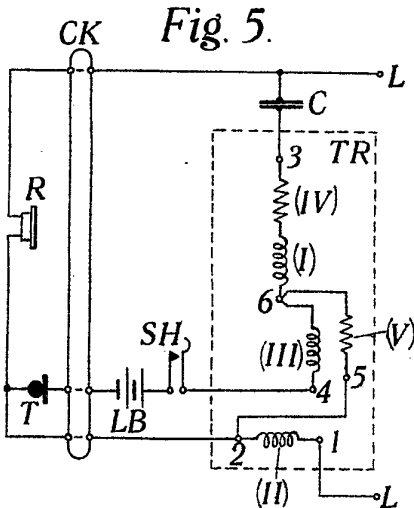


Fig. 6.

