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Improvements relating to Telephone Instrument Circuits

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PATENT SPECIFICATION

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Complete Left: Sept. 30, 1931.

Complete Accepted: Dec. 24, 1931.

PROVISIONAL SPECIFICATION.

Improvements 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 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:—

The present invention relates to telephone instrument circuits and concerns circuits having side tone suppressing arrangements of the nature described in Specification 263,211 or analogous thereto.

In the Specification mentioned the circuit described includes an anti-side tone transformer the primary of which is connected across the transmitter and the secondary of which is connected across the receiver.

The data for the transformer as mentioned therein is not ascertained by means of a simple formula as its effect varies with the frequency of the currents concerned, the line impedance and other factors. In practice, if the transformer is designed to operate most efficiently with lines and junctions of average length its efficiency falls off as that length is diminished.

It appears that some means are desirable for keeping the effect of the transformer at the same level with shorter lines. The present invention, inter alia, provides means for this purpose. The means employed may take the form of a resistance connected in series at any point in the branch of the circuit containing the receiver. If desired the resistance may be incorporated in the secondary of the induction coil by winding this with high resistance wire. Other means may be provided, for instance a condenser may be inserted in series with the primary winding of the anti-side tone transformer.

Where the instrument circuit is used in automatic circuits, that is to say, when a dial is associated therewith, the dial off-normal contacts should preferably short circuit the resistance as well as the receiver if the resistance is in series in the closed loop containing the bell, induction coil windings and receiver. If on the other hand, it is not in the above loop it may be in circuit during dialling and in conjunction with the condenser normally used in series with the receiver or the bell act as a spark quench.

It may also be divided into two portions one within the above loop and one in series with this condenser.

It will be clear that the means provided in the present invention may if desired be always incorporated in an instrument circuit and short-circuited in whole or in part or not as required by the circumstances in which the instrument is used. The circumstances may be such that complete or even partial suppression of side tone is not required.

Dated this 30th day of December, 1930.

SIEMENS BROTHERS & CO., LIMITED,
By their Attorney,
F. A. LAWSON,
For Selves and Co-Applicant.

COMPLETE SPECIFICATION.

Improvements 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 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:—

The present invention relates to telephone instrument circuits and concerns circuits having side-tone suppressing

[Price 1/-]

arrangements of the nature of or analogous to those described in Specification No. 263,211.

In the Specification mentioned the circuit described includes an anti-side tone transformer the primary of which is connected across the transmitter and the secondary of which is connected across the receiver, respectively, of a telephone instrument.

The transformer produces in its secondary circuit, which is shunted across the receiver, an e.m.f. of a value sufficient to reduce to zero the voltage across the receiver produced by the e.m.f. generated in the microphone, provided that the instrument circuit is connected to a line having a specific impedance.

The data for the transformer as mentioned in 263,211 is not ascertained by a simple formula as its effect varies with the frequency of the currents concerned, the line impedance and other variable factors. In practice if the transformer is designed to operate most efficiently with lines and junctions of average length its efficiency diminishes as the length of line or junction diminishes.

When the impedance connected to the line terminals has a certain value the current flowing through C and SI is completely diverted through winding *m*2. The current through R is then zero and side tone is completely suppressed.

If the certain value of impedance above referred to is departed from a certain amount of side-tone is introduced. Until, however, the line impedance departs comparatively considerably from the certain value, the degree of side-tone is insufficient to affect the operating efficiency of the circuit. When the line impedance becomes relatively low or more particularly when it has a lagging instead of a leading angle (measured at mean speech frequencies) the degree of side tone may be sufficient to affect the operating efficiency of the circuit. Such a condition occurs in practice when the circuit is connected to a similar circuit by a short connecting line and a current feeding bridge or repeating coil circuit. Under these conditions the ratio of current in R to the alternating voltage at T and consequently the side tone may be considerable.

In order that side tone may be entirely eliminated the whole of the current produced in the circuit C—SI etc., must be diverted from the receiver through *m*2. Under the line conditions referred to in the preceding paragraph this diversion of current can be assisted by increasing the output of the transformer or by decreasing the current in the circuit C—SI etc. As it is not desirable for considerations of standardization to alter the transformer characteristics we have introduced a resistance into the circuit C—SI etc. Using the apparatus described in Specification No. 263,211 we find that the best average resistance value is of the same order as the resistance component of the impedance of the line with which the circuit is designed to work. The best average resistance is of the order of 500 ohms, but, of course other values, between, say, 200 and 600 ohms are suitable for differing conditions.

Although the resistance does, under controlled quiet conditions, reduce the transmission and reception efficiency of the circuit yet the working efficiency, that is the efficiency of the circuit judged under working conditions is higher than the efficiency under quiet conditions. In other words, the reduction of side tone due to noise is so great that the contrast between side tone noise and received speech amply compensates for any reduction of received speech level caused by the presence of the resistance.

The object of our invention is to provide in a telephone instrument provided with a device of the type referred to, a simple means for compensating for lines of low impedance or lagging impedance angle without having to alter the characteristics of the device when such is designed for lines of another impedance.

In order to distinguish between the two portions of the part of the circuit which contains the receiver and transformer-secondary SI (see Fig. 2), the whole branch consisting of C, X, SI, R and *m*2 may be considered as the secondary circuit, the loop R, *m*2 as the "branched portion" of the secondary circuit, and the remainder of the secondary circuit as the "unbranched portion".

Since we achieve the object of our invention by increasing the resistance of the unbranched part of the secondary circuit in comparison with the resistance of the secondary circuit of instruments constructed for use on lines of average or usual impedance this increased resistance or the resistance of the secondary circuit as so increased will, where convenient, be referred to as a comparatively high resistance.

According to our invention we provide the combination of a telephone instrument having a device of the type referred to in parallel with the receiver with a resistance in the unbranched portion of the secondary circuit the value of which is of the same order as the resistance component of the line impedance with

which the circuit is designed to work.

Our invention will be further described in connection with the accompanying drawings of which Fig. 1 is, apparently, a reproduction of the drawing which accompanied Specification No. 263,211. It is only apparently so since it shows a bell circuit and includes a modification referred to later. Fig. 2 shows a method of including the comparatively high resistance in such a circuit. Figs. 3 and 4 show how a dial switch would be connected into the arrangements shown in Figs. 1 and 2, and Fig. 5 shows a further method of including the comparatively high resistance and a dial.

The increase of resistance may be effected by introducing a resistance, shown at X in Fig. 2, into the secondary circuit. This resistance may be included in any unbranched part of the secondary circuit, that is in any part that includes in series, the condenser C, secondary winding SI, and receiver R and transformer coil *m*2 in parallel.

It may, therefore, be wound separately and constitute a separate unit mounted on the case containing the condenser, or it may be made integral with winding SI, or it may be mounted on the bobbin of the anti-side tone transformer M.

For the reduction of side tone these methods are equally effective. They are equally convenient for instruments for use in manual systems but are not equally convenient for instruments for use in automatic systems.

In Fig. 2 of this specification we show the essential components of our invention. The transformer P1, S1, the anti-side tone transfomer M, the condenser C, and the microphone T all have the proportions assigned to them in our Specification 263,211. The receiver R may have an impedance of about 300/60° at 800 cycles per second. The compensating resistance is shown at X. So far as currents of speech frequency are concerned the bell (BE) has a negligible effect and need not be considered.

In Fig. 1 the simplest arrangement is shown. The resistance of the winding SI is increased to the desired value of about 500 ohms by making the winding of resistance alloy wire instead of copper. The bell is connected to the lower terminal of the condenser C and the switch hook contacts are shown at *sh*. This circuit is suitable for use on manually operated switching systems.

If a dial is required it would be connected into the circuit in the manner shown in Fig. 3, where IM are the impulse springs and N1 and N2 the off normal springs. During dialling the contacts N1 and N2 are closed. The charging and discharging currents flowing in and out of the condenser now flow through the comparatively high resistance winding SI. As the bell is in the loop containing this resistance it is affected by the voltage across SI. In certain circumstances the magnetic bias of the bell movement is insufficient to prevent it tinkling during dialling. This circuit if used for automatic systems is therefore suitable only for such systems if the bell is properly biassed to prevent tinkling under the influence of transient voltages.

In Fig. 4 the resistance is shown as wound separately and as connected between the condenser C and secondary winding SI. This circuit is so arranged that the transient voltages produced across X during dialling are not applied to the loop containing the bell. The resistance X is in this case wound in a suitable form and may be mounted in or on the case of the condenser C thus producing a unit with 3 terminals. This circuit is suitable for automatic manual switching systems and may be used with bells which are not specially biassed against transient voltages. The presence of the resistance X in series with the bell and condenser during ringing with current of 16 cycles does not affect the operation of the bell since the reactance of the condenser C at this frequency is so high that 500 ohms at X make little difference to the current in the bell.

In Fig. 5 the resistance is also shown wound separately and is connected between the secondary winding SI and the junction of secondary winding *m*2 of transformer M and the receiver. In this arrangement off normal contact N2 is arranged to short circuit the resistance X during the dialling operation. As the contact N1 short circuits the transmitter at the same time, the receiver R is made completely dead. In this arrangement the resistance X may be wound on the same assembly as the transformer M, thus producing a unit with 5 terminals.

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:—

1. A telephone instrument, having for the purpose described, a device of the type referred to (transformer M) and a secondary circuit the resistance of which is of the same order as the resistance component of the line impedance with which the instrument is designed to operate.

2. A telephone for use in a central

battery system having a hand microphone combination, a device of the type referred to (transformer M) and a secondary circuit the resistance of which is of the same order as the resistance component of the line impedance with which the instrument is designed to operate.

3. A telephone instrument for use in a central battery telephone system having an impulse dial, a device of the type referred to (transformer M), and a secondary circuit the resistance of which is of the same order as the resistance component of the line impedance with which the instrument is designed to operate.

4. A telephone instrument according to Claims 1 and 3 in which a resistance of the same order as the resistance component of the line impedance with which the instrument is designed to operate is included in the unbranched part of the secondary circuit.

5. A telephone instrument according to Claims 1 and 3 in which the secondary winding of the usual induction coil constitutes the resistance referred to.

6. For use in a telephone instrument according to Claims 1—5 the combination as a five terminal unit of an anti-side tone transformer and the resistance referred to.

7. For use in a telephone instrument according to Claims 1—5 the combination as a three terminal unit of a condenser and the resistance referred to.

8. A telephone instrument according to Claim 3 in which the resistance referred to is included in the secondary circuit at a point outside the loop formed by the bell and the remainder of the secondary circuit substantially as and for the purpose described in connection with Fig. 4.

9. A telephone instrument according to Claim 3 in which the resistance referred to is included in the secondary circuit at a point within the loop formed by the bell and the remainder of the secondary circuit and in which the off-normal springs of the dial are arranged substantially as and for the purpose described in connection with Fig. 5.

Dated this 30th day of September, 1931.

SIEMENS BROTHERS & CO.,
LIMITED,
By their Attorney,
F. A. LAWSON,
For Selves and Co-Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1932.

Fig. 1.

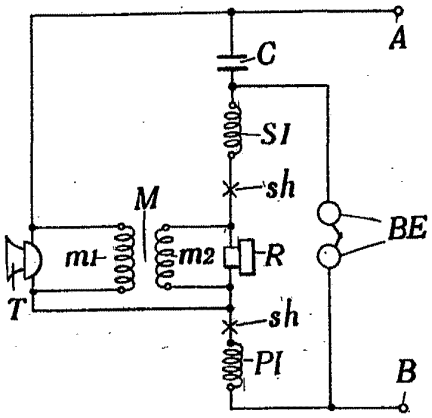


Fig. 2.

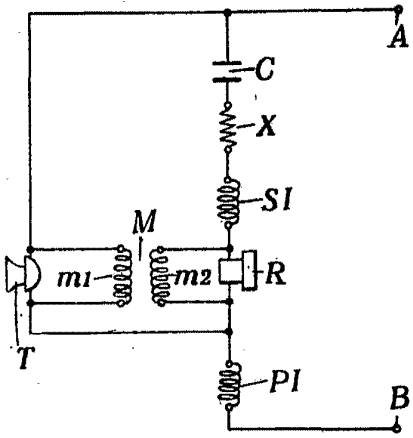


Fig. 3.

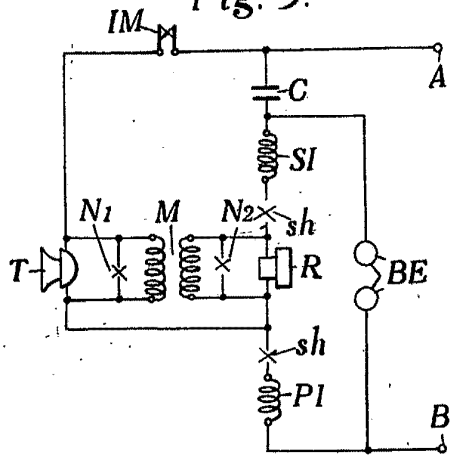


Fig. 4.

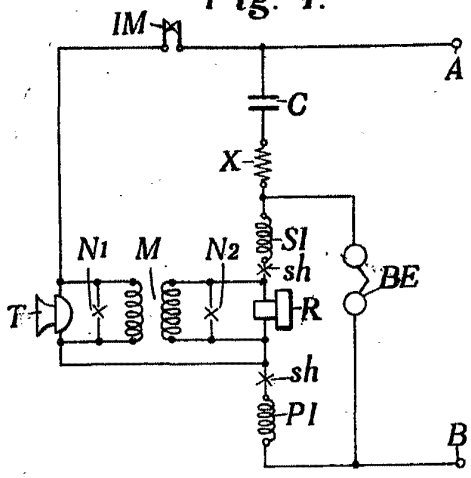
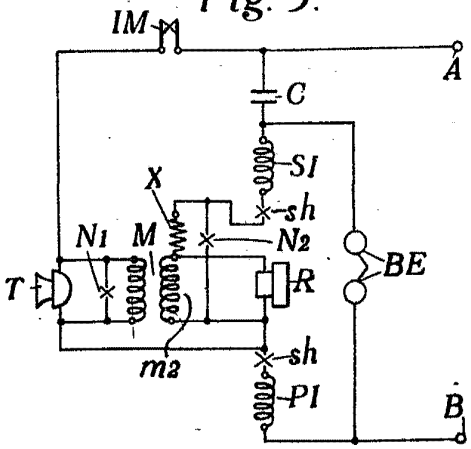


Fig. 5.



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