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Complete Specification entitled (54) TELEPHONE TRANSMITTER AMPLIFIER.

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Related Art (56)

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200,418(1382/54)	05.7.
216,267(30,977/57)	05.6; 05.7.

The following statement is a full description of this invention, including the best method of performing it known to us :

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The object of this invention is to provide an amplifier, which when used in combination with a dynamic microphone, is capable of being used in direct substitution for the well-known carbon granule transmitter used in telephone subscribers' handsets and like applications.

Carbon granule transmitters have been used in telephone work for many years. However, there has now arisen the need to replace this type of transmitter with one exhibiting superior life and characteristics, that is, a dynamic microphone. The problems attendant upon this substitution are many. They will be outlined briefly for a clearer understanding of the features and advantages of the novel amplifier to be described herein.

It is well known that a dynamic microphone does not possess the high "gain" of the carbon granule transmitter. It is necessary, therefore, to provide an amplifier to lift the signal level to an acceptable level. Where the question of direct and compatible substitution arises, as it does in telephone work, not only must the overall transducer gain be substantially similar, but the replacement item(s) must accept working conditions determined by existing plant. In the case of telephone plant, these conditions impose appreciable difficulties in the design of a suitable amplifier.

For example, in the Australian Post Office telephone system the nominal power supply is 50 volts DC, the limits being 46 - 52 volts. This power supply is provided from a source having zero internal impedance, and is applied to a subscriber line through exchange equipment having a minimum current requirement of 25 mA, an internal resistance of 400 ohms minimum and an inductive reactance which is high in relation to the signal load circuit connected in parallel

therewith. The nominal value for the signal load is 600 ohms, capacitively coupled. The minimum output signal developed across the exchange load is 1.8 volts p-p, or a current of 3 mA p-p into the nominal 600-ohm load.

The two wires connecting a subscriber to the exchange may have a total resistance of any value up to an upper limit of 1100 ohms. This means that as far as the amplifier is concerned, the power supply can have an effective source impedance in the range 400-1500 ohms, and the load can have a value in the range 600 - 1700 ohms, assuming a nominal 600 ohms in the exchange equipment. In fact, because there can be appreciable departure from the nominal value, the actual effective range of load value is accepted as 150-2300 ohms. Compatibility considerations call for a D.C. current into the subscriber circuit from the exchange of not more than 120 mA, and preferably not more than 80 mA.

Under the varying conditions just described, the amplifier must provide the minimum output stated when driven from a low-impedance microphone (say 15-50 ohms). The power supply for the amplifier and the output signal must travel over the one subscriber pair (line), as is customary, and there is a further requirement that the amplifier must be able to accept a reversal of DC polarity on the line.

It is clear from the foregoing that the design of a suitable amplifier for this application presents many difficulties. These difficulties are increased still further when other more obvious requirements are considered. For example, the amplifier must be simple and cheap, as very large quantities will be required, and it must be very tolerant to component parameter tolerances.

According to this invention a telephone transmitter amplifier is characterised by the fact that it functions as a constant voltage device in respect of the DC supply and as a constant current device in respect of signal ~~input~~ output.

According to a further development of this invention, the amplifier is characterised by the connection of a plurality of current-steering diodes between the amplifier circuit and the telephone line.

According to a further development of this invention the amplifier ~~comprises~~ contains a resistor which is effectively in series with the telephone line.

One example of a telephone transmitter amplifier in accordance with this invention is shown in the accompanying diagram. The example of the novel amplifier is shown in area A of the diagram, whilst areas B and C show respectively the subscriber line and the simulated associated exchange equipment. The exchange equipment includes the nominal 600-ohm load, which is capacitively coupled. The subscriber line L may, as mentioned above, have any value up to 1100 ohms.

In the example of a novel amplifier shown in area A of the diagram, two transistors T1, T2 of opposite conductivity type are directly coupled. The dynamic microphone M is connected in the emitter circuit of transistor T1, in series with a resistor R3. The base of transistor T1 is connected to a potential divider consisting of resistors R1, R2, and is decoupled for alternating (signal) variations by capacitor C1. The effective load for the collector of transistor T2 is R5 + L + the exchange equipment, shunted by the first stage of the amplifier. However, the impedance presented by this first stage is

comparatively high and can therefore be neglected for general purposes.

The connection of the first stage of the amplifier directly to the collector of transistor T2 together with the direct coupling between the two transistors themselves produces very heavy DC feedback. This in turn results in a constant value of the voltage developed across the supply input to the amplifier, that is, between the collector and emitter of T2. This renders the amplifier independent of line length and other variations and ensures that the amplifier always receives the designed operating voltage by allowing the amplifier itself to adjust for the design voltage by varying the emitter-to-collector impedance of transistor T2. This overcomes a number of problems associated with the power supply, such as variation of component parameter tolerances, variation of line length, variation of supply voltage and variation of supply voltage source impedance.

Although heavy DC feedback is used in the amplifier, there is no AC feedback. This means that the output impedance of the amplifier for signal variations is high in relation to the impedance formed by R5, L and the exchange equipment. This results in the amplifier behaving as a constant current source as far as the output signals are concerned, and this reduces the effect of line-length variations on the signal developed across the nominal 600-ohm load.

The use of R5 is optional. It is useful in some cases to reduce the amount by which current flowing into the subscriber circuit from the exchange equipment will vary, but has little or no effect on the basic operation of the amplifier as already described. The diodes D1-D4 perform

a known function as steering diodes and ensure that correct polarity is always applied to the amplifier irrespective of polarity on the line.

It is seen that the novel amplifier substantially overcomes the difficult and unusual problems presented by the application for which it is intended. Furthermore, as can be seen from the example described herein, it is possible to realise the amplifier with a small number of low-cost components, or with a correspondingly simple integrated circuit component.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A telephone transmitter amplifier characterised in that it functions as a constant voltage device in respect of its DC supply and as a constant current device in respect of signal output, wherein the circuit of said amplifier comprises first and second transistors of opposite conductivity directly coupled, and wherein a dynamic microphone is connected in series with the emitter circuit of the first transistor and a first resistor, the base of said first transistor being connected to a potential divider comprising second and third resistors and being also decoupled by a capacitor adapted to pass signal currents.

2. A telephone transmitter amplifier as claimed in claim 1, wherein a plurality of current-steering diodes is connected between the circuit of said amplifier and a telephone line.

3. A telephone transmitter amplifier as claimed in claim 2, wherein a resistor is effectively in series with said telephone line.

4. A telephone transmitter amplifier as claimed in claim 1, wherein the first stage of said amplifier circuit is connected directly to the collector of a second transistor, and wherein said transistors are directly coupled so as to produce sufficiently heavy DC feedback to result in a constant value of the voltage developed across the supply input to

said amplifier between the collector and emitter of said second transistor.

5. A telephone transmitter amplifier as claimed in claim 4, wherein the emitter-to-collector impedance of said second transistor is adjustable.

6. A telephone transmitter amplifier as claimed in any one of the preceding claims, characterised by the fact that the amplifier is constructed as an integrated circuit.

7. A telephone transmitter amplifier substantially as described with reference to the accompanying drawing.

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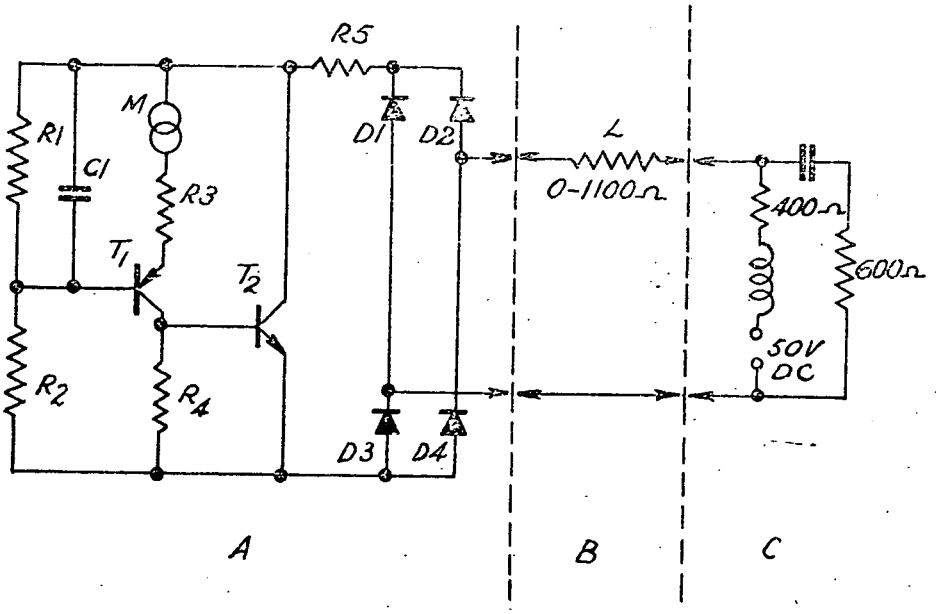

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