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2,566,057

AUDIO AMPLIFIER SYSTEM

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Fig. 1.

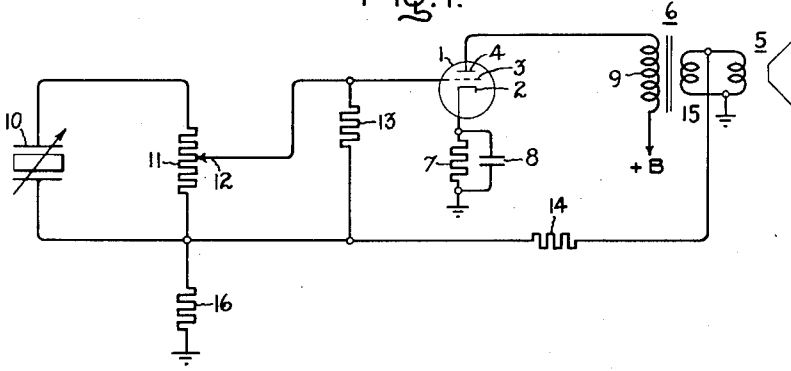
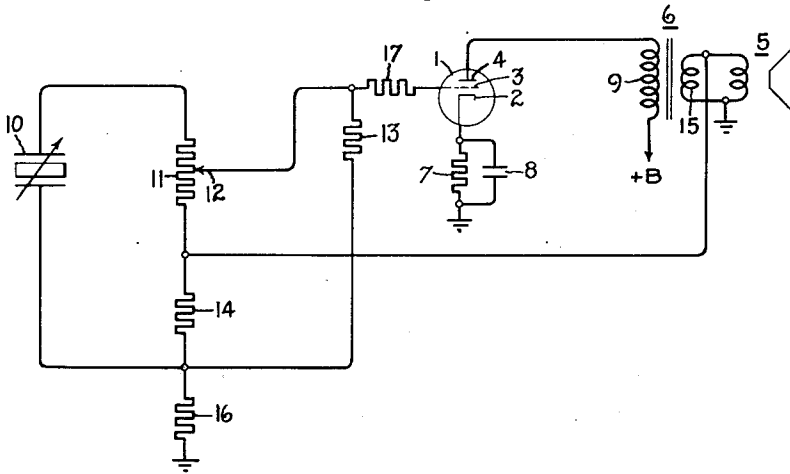


Fig. 2.



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AUDIO AMPLIFIER SYSTEM

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1 Claim. (Cl. 179—171)

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My invention relates to audio amplifier systems, and more particularly to degenerative feedback circuits which may be employed in such systems. It is a primary object of my invention to provide an improved degenerative feedback circuit for audio amplifier systems such as those employed in phonograph reproducers.

In order to provide stability of operation and high fidelity sound output from an audio amplifier, it is customary to feed back a portion of the output voltage in degenerative phase to the input circuit. In the past, such feedback voltage has been supplied in parallel with the input voltage. It is a particular object of my invention to provide a circuit for applying a portion of the output voltage of an audio amplifying system degeneratively in series with the input voltage, thereby obtaining improved fidelity of voltage output.

Another object of my invention is to provide means for applying a constant percentage, independent of the volume control setting, of the output voltage of an audio amplifier degeneratively to the input circuit.

A further object of my invention is to provide, for a phonograph reproducer, feedback means which permit a limited variation of the magnitude of the negative feedback voltage with the volume control setting, in order that the gain of the amplifier and its associated phonograph pickup at maximum volume control setting may be established at a desirable level and a high degree of feedback may be utilized at low volume levels.

Another object of my invention is to provide a negative feedback circuit for use in an audio amplifier system wherein the phase of the feedback voltage is invariant with the volume control setting.

A still further object of my invention is to provide means for obtaining sound output of fidelity comparable to that obtained by the use of bass compensation networks without using such networks, thereby effecting a considerable economy of parts and reduction of cost.

The features of my invention which I believe to be novel are set forth with particularity in the appended claim. My invention itself, however, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which Fig. 1 is a schematic circuit diagram of a audio amplifier which suitably embodies my invention, and Fig. 2 is a modification of the circuit of Fig. 1. In the drawings, like reference numerals indicate like elements.

Referring to Fig. 1, an audio frequency amplifier, comprising an electron discharge device 1 having a cathode 2, a control grid 3 and an anode 4, is shown supplying audio frequency currents

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to a loudspeaker 5 through the conventional output transformer 6. For purposes of illustration, I have shown a single stage amplifier, however, it will be understood that two or more stages may be used. The customary cathode bias resistor 7 and bypass condenser 8 are provided and positive unidirectional energizing voltage, conventionally designated as +B, is supplied to the anode 4 of device 1 through the primary winding 9 of output transformer 6.

A source of audio frequency signal voltage, which is shown comprising a crystal pickup 10 of a phonograph reproducer, is connected across a volume control potentiometer 11, the movable contact 12 of which is connected to the control grid 3 of device 1. Crystal 10 may be considered as constituting a voltage source in series with a capacitance. If the crystal is returned directly to ground, as is the case in circuits using parallel feedback, it acts as a capacitive shunt across the feedback resistor, thus effecting undesirable phase shift in the feedback voltage. My circuit precludes such phase shift, since the crystal 10 is returned in series with the feedback resistor 16. Resistance 13 is shown shunting the output portion of potentiometer 11. The function of resistance 13 is to offer a high impedance load to the crystal pickup 10 at low level audio gain and a low impedance load for high level audio gain. Due to the capacitive nature of the crystal pickup 10, this variable loading provides continuous bass compensation without the need for capacitors or other circuit components and without appreciable loss of input voltage.

I provide means for applying a portion of the output voltage degeneratively in series with the input circuit, such means as shown embodying a resistor 14 connected between one side of the secondary 15 of output transformer 6 and the low potential end of volume control potentiometer 11, and another resistor 16 connected between the low potential end of potentiometer 11 and ground. The other side of the secondary winding 15 of output transformer 6 is directly connected to ground. In this manner, a portion of the output voltage is developed across the feedback resistor 16 and is supplied in series with the signal input voltage appearing across resistance 13 to the grid 3 of amplifier tube 1. Since a 180-degree phase shift occurs in device 1, the feedback voltage is in degenerative phase with the input voltage. Furthermore, the percentage of the output voltage so applied to the input circuit is constant, depending only on the relative values of the feedback resistances 14, 16, and is independent of the position of the movable contact 12 of volume control potentiometer 11. By a proper selection of the values of feedback resistances 14, 16, undesirable overloading of the amplifier at maximum volume control setting is

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avoided, and the largest amount of feedback consistent with the pickup voltage and the amplifier gain is obtained.

In the circuit of Fig. 2, the ungrounded side of the secondary winding 15 of output transformer 6 is returned directly to the low potential end of the volume control potentiometer 11, and the crystal pickup 10 and its loading resistor 13 are returned to the junction of the feedback resistors 14, 16. In this case the feedback voltage divider again comprises resistors 14, 16 and the degenerative feedback voltage developed across resistance 16 is again applied in series with the input voltage to the grid 3 of device 1. In addition, a current limiting resistance 17 is provided between the high potential side of the grid leak resistance 13 and the grid 3 of device 1. Further explanation of the circuit of Fig. 2 is omitted since in all other respects the circuits of Figs. 1 and 2 are identical.

It will be seen that due to the resistive nature of the feedback voltage divider employed in the circuits of Figs. 1 and 2, the phase of the feedback voltage is independent of volume control adjustment. Furthermore, the percentage of the output voltage which is fed back in degenerative phase with the input voltage is independent of volume control adjustment. As a further modification, a limited variation of the magnitude and phase of the feedback voltage with volume control adjustment may be obtained by employing suitable reactive elements in conjunction with the feedback voltage divider.

While I have shown and described particular embodiments of my invention, it will be understood that numerous variations and modifications may be made, and I contemplate in the appended claim to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

In a phonograph reproducer of the type having a crystal pickup device adapted to gen-

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erate alternating voltages extending over an audio frequency band, said device having inherent capacitive reactance, a pair of resistances connected in series circuit with said pickup device, said series circuit having a low potential point and a high potential point, one of said resistances being connected to said high potential point and having a variable tap, a third resistance connected between said tap and said low potential point, an electron discharge device having an input electrode connected to said tap, said device having an output circuit having a grounded connection, and a connection from a point on said output circuit displaced from said grounded connection to the common terminal of said pair of resistances, said low potential point being connected to ground through a fourth resistance, the other of said pair of resistances and said fourth resistance forming a feedback circuit to supply a constant percentage of the voltage of said output circuit in degenerative phase with respect to the corresponding input voltages within said band which are supplied to said input electrode by said pickup device.

GEORGE F. DEVINE.

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