Aug. 27, 1940. B. D. H. TELLEGEN ET AL 2,212,850

INSTALLATION FOR REDUCING NONLINEAR DISTORTION IN AMPLIFYING SYSTEMS

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Fig. 1

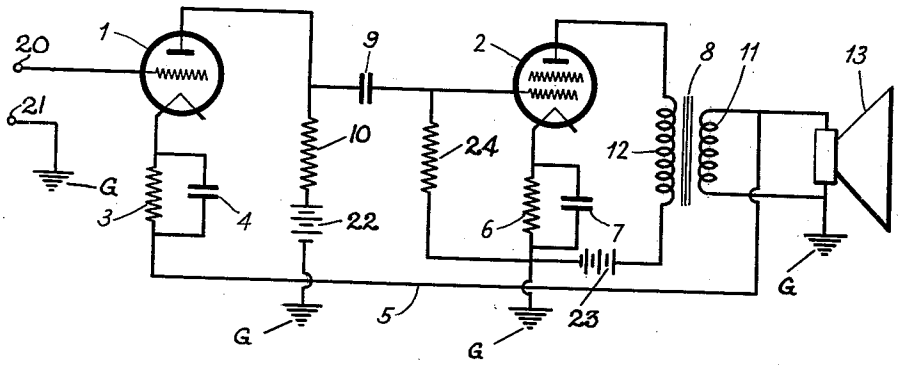


Fig. 2

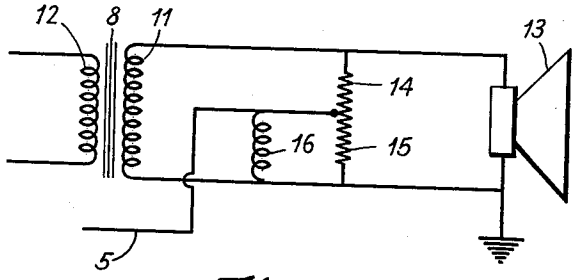
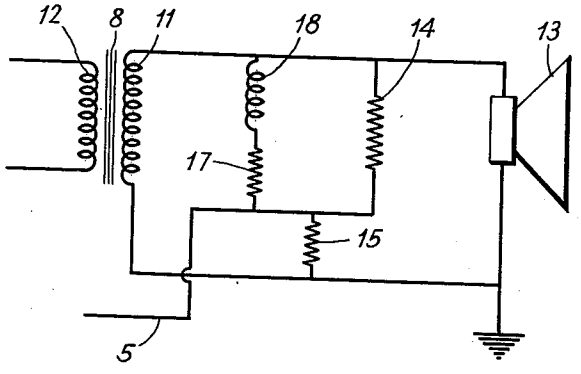


Fig. 3



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INSTALLATION FOR REDUCING NONLINEAR DISTORTION IN AMPLIFYNG SYSTEMS

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4 Claims. (Cl. 179—171)

According to U. S. Patent No. 1,996,830, which concerns a device for reducing nonlinear distortion in amplifying systems, part of the output voltage, which is large for all frequencies in comparison with the reciprocal value of the degree of amplification which is obtainable without retroaction, is fed back in negative sense to the input circuit of the amplifier. In the forms of construction shown in said patent the voltage to be fed back is taken for this purpose from a resistance connected in the anode circuit of a tube.

The present invention has for its object to improve the arrangement set out in said patent for the case where the load is connected to the amplifier via a so-called output transformer. The improvement consists in that the voltage to be fed back is taken from the secondary side of said output transformer. As such may be utilized either the supply winding itself or a tertiary winding.

Besides that with the use of an output transformer one is free in the choice of the point of the load circuit that is to be earthed and that it is no longer necessary to have regard to the continuous current, one obtains in this manner still further advantages. Thus any nonlinear distortion produced in the output transformer due to phenomena of saturation, can be suppressed to a higher extent. If, as is often the case, use is made of a step-down transformer and the voltage to be fed back is taken from impedances connected into the load circuit, these impedances, resistances or inductances may have low values because the voltage in the output circuit has a comparatively small value and the current has a high value.

If use is made of a step-down transformer, feeding back should preferably take place to the input circuit of an amplifying tube preceding the end tube in order to obtain a sufficiently strong retroaction.

The accompanying drawing represents diagrammatically by way of example a few modes of realization of amplifiers according to the invention. Figure 1 represents the last two stages of an amplifier according to the invention while Figures 2 and 3 represent slightly modified arrangements of the load circuit.

In Figure 1, 1 and 2 denote cascade-connected amplifying tubes. The voltage to be amplified is supplied to the grid of tube 1 by connection of a suitable source between the input terminals 20 and 21 and the anode circuit of this tube is coupled by means of a condenser 9 and a resistance 10 with the grid circuit of tube 2. The required negative bias voltages are obtained by means of resistances 3 and 6 respectively which are shunted by condensers 4 and 7 respectively. Into the anode circuit of the tube 2 is connected the primary winding 12 of a transformer 8 to the secondary winding 11 of which is connected a load 13. The whole voltage set up across the secondary winding is supplied to the input circuit of the preliminary tube 1 through the intermediary of a lead 5 which is connected to the lower point of the resistance 3. Space current for the tubes 1 and 2 is supplied by any suitable source represented generally by the batteries 22 and 23 respectively.

In the form of construction according to Figure 2 only part of the output voltage is fed back; for this purpose the lead 5 is connected to the common point of two resistances 14 and 15 connected in series between the secondary transformer terminals. An inductance 16 is located in parallel with the resistance 15. It is thus ensured that the low frequencies are less attenuated than the high ones.

In a practical form of construction the amplication from the grid of tube 1 to the anode of tube 2 was 1200. The ratio of the numbers of turns of the transformer was 30:1. The resistances 14 and 15 had a value of 200 and 25 ohms respectively and the inductance of 0.04 henry.

According to Figure 3 a series-connection of a resistance 17 and an inductance 18 is located in parallel with the resistance 14. Such a circuit-arrangement has to be utilized with the connection of loudspeakers with which it is essential to make the higher frequencies more prominent. It may be obtained in this case that with the higher frequencies the current is kept substantially constant and that with the lower frequencies the voltage is maintained constant with the result that the lower resonance peak of the loudspeaker is damped. The same effect may be obtained by utilizing a capacity in the load circuit.

We claim:

1. In an amplifier adapted to energize a variable impedance load, an output stage including a screen grid tube provided with an input circuit and an output circuit, a transformer connecting said output circuit to the load, a driver circuit for the output stage including an electronic tube having an anode, a cathode and a grid electrode, a source of signal energy, including a pair of terminals, means for maintaining

one of said terminals at a fixed potential, means for maintaining said grid electrode at the potential of the other terminal of said source, and a connection for impressing at least a portion of the voltage developed across the secondary of said output transformer between the cathode of said tube and a point of fixed potential, said last named connection being arranged to be traversed by the entire space current of said electronic tube, and the potential variations so impressed upon said cathode having a polarity in phase with the potential variations of said grid.

2. In an amplifier circuit adapted to energize a variable impedance load, an output stage including a first electronic tube provided with an input circuit and an output circuit, means including a transformer for connecting said output circuit to the load, a driver circuit for the output stage including a second electronic tube having an anode, a cathode and a grid electrode, a source of signal energy including a pair of terminals across which the signal energy voltage is available, means for connecting one of said terminals to a point of fixed potential, means for maintaining said grid electrode at the potential of the other terminal of said source, means including a resistor device for connecting the cathode of said electronic tube to a point of the secondary winding of said transformer, and means for connecting another point of said secondary winding to said point of fixed potential, said two last named means acting to impress at least a part of the voltage developed across the secondary winding of said transformer between the cathode of said tube and the point of fixed potential, said connection between the cathode and the secondary of the transformer being arranged to be traversed by the entire space current of said second electronic tube, said transformer windings being so poled and said connection between the transformer secondary and said cathode being so constituted that the variations of potential impressed on said cathode are in phase with the variations of potential impressed on said grid.

3. In an amplifier adapted to energize a load which has a variable impedance due to mechanical resonance, an output screen grid tube having an input circuit and an output circuit, said output circuit including an output transformer across the secondary of which the load is adapted to be connected, a driver circuit for said output tube comprising an electronic tube having an anode, a cathode and a grid electrode, means adapted to be connected to a source of alternating current energy to be amplified for impressing said energy between the grid electrode of said electronic tube and a point of fixed potential, an output circuit for said electronic tube, means for coupling said last named output circuit to the input circuit of said output tube and means including a direct current connection between the cathode of said electronic tube and a point of the secondary winding of said transformer for impressing at leasts a portion of the voltage developed across the secondary of said transformer between the cathode of said electronic tube and the point of fixed potential, the winding of said transformer being so poled and said coupling means being so constituted that the variations of potential impressed on said cathode are in phase with the variations of potential impressed on said grid by said energy.

4. In an amplifier for audio frequencies, said amplifier being adapted to energize a variable impedance load, a screen grid output tube having an input circuit and an output circuit, a transformer connecting said output circuit to the load, a driver circuit for said screen grid tube including an electronic tube provided with an anode, a cathode and a grid electrode, a pair of terminals one of which is connected to a point of fixed potential and the other thereof being being maintained at a potential which varies with respect to the fixed potential in accordance with signal energy to be amplified, means for maintaining said grid electrode at the potential of said last named terminal, a connection including means for providing less attenuation for audio frequencies in a portion of the audio frequency spectrum than in another portion thereof for impressing at least a portion of the voltage developed across the secondary of said output transformer between the cathode of the tube and said point of fixed potential, said last named connection being arranged to be traversed by the entire space current of said electronic tube, the potential variations so impressed upon said cathode having a polarity in phase with the potential variations impressed upon said grid electrode.

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