

March 4, 1941.

J. A. J. BOUMAN ET AL

2,233,767

AMPLIFIER VOLUME CONTROL

Filed Oct. 22, 1938

Fig. 1

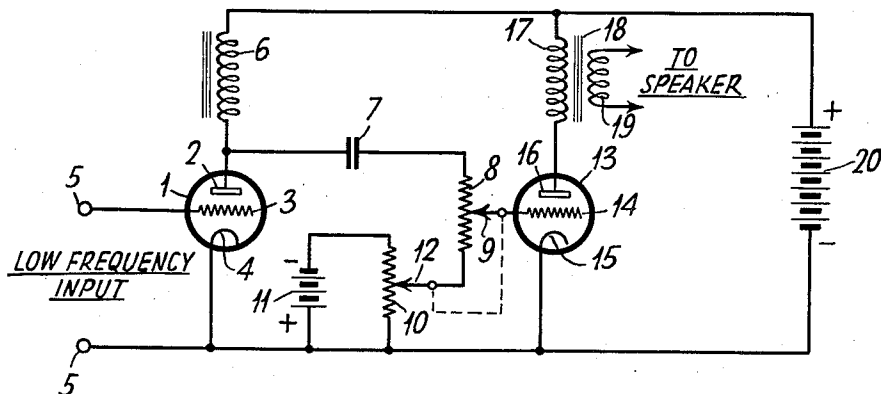
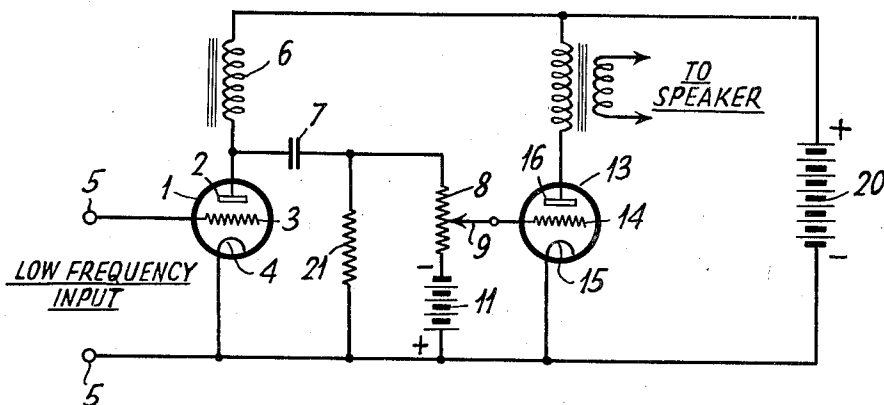


Fig. 2



INVENTORS
JOHANNES A. J. BOUMAN
ROBERT G. CLARK
BY *H. S. Swover*
ATTORNEY

UNITED STATES PATENT OFFICE

2,233,767

AMPLIFIER VOLUME CONTROL

Johannes Augustinus Josephus Bouman, Eindhoven, Netherlands, and Robert George Clark, Beckenham, England, assignors, by mesne assignments, to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application October 22, 1938, Serial No. 236,418
In Germany December 6, 1937

5 Claims. (Cl. 179—171)

The invention relates to a low-frequency amplifier with volume control comprising means which permit alteration of the direct current bias of a tube, more particularly the final tube, for the purpose of adaptation to the alternating current output of said tube. Particularly with battery receivers it is advantageous to utilize such circuit arrangements which afford great economy in current.

For saving current in a receiver it is already known to reduce the anode voltage of the whole of the apparatus by utilizing a tap on the secondary winding of the supply transformer. A drawback of such an arrangement is that the reduction of the anode voltage of the whole of the device entails an appreciable reduction of the total amplification of the receiver with the result that, for example, comparatively weak transmitters can no longer be received. Furthermore, with such an arrangement it is impossible to obtain for any adjustment of sound volume each time the most favourable adaptation of the direct current bias.

The above mentioned drawbacks are avoided if, in accordance with the invention, the negative control grid bias of a tube, more particularly the final tube, can be adjusted in a non-stepwise manner by means of a potentiometer, or a variable resistance, which is automatically adjusted together with the volume control device in such manner that the negative grid bias increases with decreasing sound volume.

The invention is consequently based on the recognition that the most favourable conditions as regards economy in current, are only obtained if with any adjustment of sound volume the direct current bias of a tube automatically matches the alternating current output of this same tube.

According to one advantageous embodiment of the system according to the invention, the arrangement is such that with any adjustment of sound intensity the corresponding negative control grid bias has such a value that the maximum variations in the control voltage which occur with this adjustment of the volume control device control the tube exactly down to the lower bend in the grid voltage-anode current characteristic curve.

The invention will be explained more fully with reference to the accompanying drawing which represents, by way of example, two embodiments thereof. In the embodiment shown in Fig. 1, the volume control and the adjustment of the control grid bias are each effected by a potentiometer included in the input circuit of the final tube of

an amplifier. In the embodiment according to Fig. 2, the volume control and the adjustment of the control grid bias are effected by means of a single potentiometer.

Referring to Fig. 1, the low-frequency voltages to be amplified are supplied by terminals 5 to the control grid 3 of a preliminary amplifying tube 1 which is supplied, through a low-frequency choke coil 6, by a source 20 of direct current voltage. The anode 2 of the tube 1 has connected to it a condenser 7 which is connected to one end of a sound volume control resistor device 8. The other end of the latter device is connected to the slide contact 12 of a potentiometer, the resistor 10 of which is connected in parallel with a source 11 of direct current, and which serves to adjust the negative bias voltage supplied to the grid 14 of the final tube 13. The sound intensity is adjusted by displacing the slide contact 9 which is directly connected to the grid 14 of the final tube 13. According to the invention, the two slide contacts 9 and 12 are mechanically coupled in such manner that the negative grid bias increases when the sound volume decreases. The final tube 13 comprises a cathode 15 and an anode 16 which is connected, through the primary winding 17 of an output transformer 18, to the source of voltage 20. The secondary winding 19 of the transformer 18 is connected, for example, to a loudspeaker (not shown).

A very advantageous embodiment of the system according to the invention is shown in Fig. 2 in which the same reference numerals are chosen to denote components similar to those of Fig. 1. One of the ends of the resistor 8 is connected to the negative terminal and the other end, through a fixed resistance 21, to the positive terminal of a source 11 of direct current. At the volume control device there is thus produced such a direct current voltage drop that in the upper position of the slide contact 9, corresponding to maximum sound volume, the negative bias applied to the grid 14 of the final tube 13 has the slightest value.

What is claimed is:

1. In combination, in an audio amplifier, a driver tube and a power output tube, said driver tube having an audio voltage input circuit and an output circuit, said output tube having at least a cathode, signal grid and output electrode, an audio output circuit connected between said cathode and output electrode, an audio voltage coupling path between the driver output circuit and said grid, a source of direct current biasing voltage between said grid and cathode, and ad-

justable impedance means included between said grid and cathode, and connected to said coupling path and biasing source, for concurrently varying the negative bias of said grid and the magnitude of the audio voltage applied to the grid in opposite senses.

2. In combination, in an audio amplifier, a driver tube and a power output tube, said driver tube having an audio voltage input circuit and an output circuit, said output tube having at least a cathode, signal grid and output electrode, an audio output circuit connected between said cathode and output electrode, an audio voltage coupling path between the driver output circuit and said grid, a source of direct current biasing voltage between said grid and cathode, adjustable impedance means included between said grid and cathode, and connected to said coupling path and biasing source, for concurrently varying the negative bias of said grid and the magnitude of the audio voltage applied to the grid in opposite senses, said impedance means consisting of a single resistor in circuit with said biasing source and coupling path, and an adjustable tap from said resistor to said grid.

3. In combination, in an audio amplifier, a driver tube and a power output tube, said driver tube having an audio voltage input circuit and an output circuit, said output tube having at least a cathode, signal grid and output electrode, an audio output circuit connected between said cathode and output electrode, an audio voltage coupling path between the driver output circuit and said grid, a source of direct current biasing voltage between said grid and cathode, adjustable impedance means included between said grid and cathode, and connected to said coupling path and biasing source, for concurrently

varying the negative bias of said grid and the magnitude of the audio voltage applied to the grid in opposite senses, said impedance means comprising a first variable resistor connected in the coupling path to said grid, and a second variable resistor connected between the biasing source and said grid.

4. In an audio amplifier comprising at least two cascaded amplifier tubes, an audio coupling path between the output circuit of the first tube and the input circuit of the second tube, a negative biasing source connected between the input electrodes of the second tube, and means connected in the input circuit of the second tube for simultaneously adjusting the magnitude of the audio voltage applied to the second tube input electrodes and for varying the value of the negative bias of the second tube in opposite senses.

5. In an audio amplifier, a first audio amplifier tube having an audio voltage input circuit and an output circuit, a second amplifier tube having at least a cathode, an input grid and an output anode, an audio coupling path between the first tube output circuit and said grid, said path including a slider element, a source of negative biasing voltage connected between the grid and cathode and including said slider element in circuit, a resistive element common to said coupling path and biasing source, and said slider element cooperating with the resistive element to vary the values of the audio voltage and biasing voltage applied to the grid of said second tube.

JOHANNES AUGUSTINUS

JOSEPHUS BOUMAN.

ROBERT GEORGE CLARK.

35