Feb. 5, 1935. A. L. TIMMER 1,990,055

AMPLIFIER CIRCUITS

Filed Oct. 28, 1931

Fig. 1

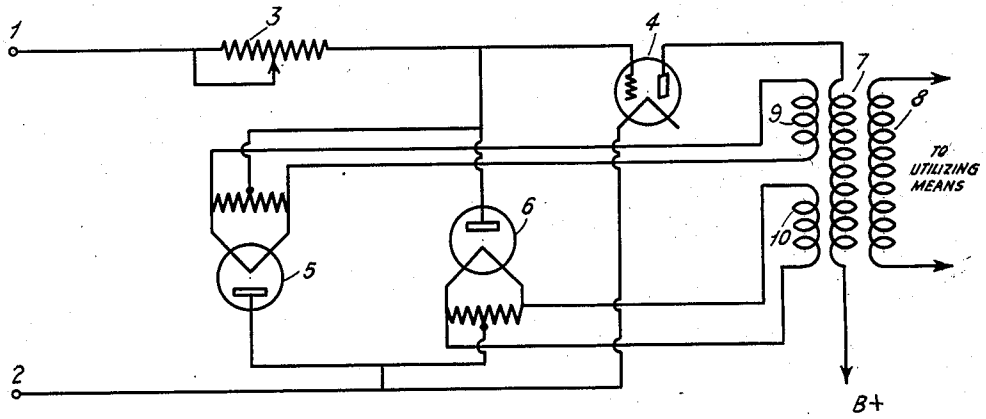
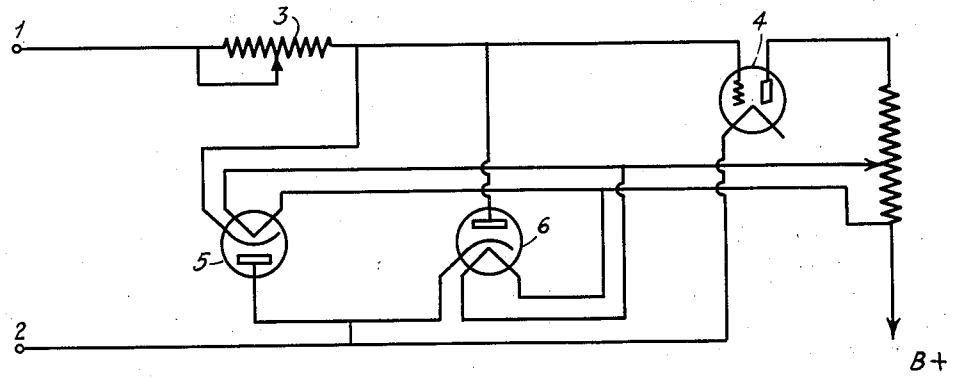


Fig. 2



INVENTOR
ANTON L. TIMMER
BY H. G. Grover
ATTORNEY

Patented Feb. 5, 1935

1,990,055

UNITED STATES PATENT OFFICE

1,990,055

AMPLIFIER CIRCUITS

Anton Leendert Timmer, Eindhoven, Netherlands, assignor to Radio Corporation of America, a corporation of Delaware

Application October 28, 1931, Serial No. 571,491
In Germany April 18, 1931

11 Claims. (Cl. 179—171)

The invention relates to a device for automatically controlling the output energy of amplifiers. An automatic volume control can be obtained by altering the grid bias of one, or more, of the thermionic tubes utilized, or, again, by bridging one, or more, circuits of the arrangement by an impedance which is variable in accordance with the intensity of the signals received.

According to the invention, use is made of the latter measure, and for the variable impedance are utilized one, or more, thermionic tubes whose cathodes are heated in dependency from the energy to be amplified.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims, the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the drawing in which I have indicated diagrammatically several circuit arrangements for carrying my invention into effect.

The invention will be explained more fully with reference to the drawing which represents, by way of example some embodiments thereof.

Fig. 1 represents a circuit arrangement in which the energy to be amplified is supplied at the points 1 and 2. The point 1 is connected, through a resistance 3, to the grid of a thermionic tube 4, and between the grid and the cathode of this tube are arranged two thermionic tubes 5 and 6 which are represented as diodes. In order to insure that both the positive and the negative portions of the potentials to be amplified are influenced in the same manner, the tubes 5 and 6 are oppositely connected.

That is to say the anode of the tube 5 is connected to the middle of the cathode of the tube 6, and the middle of the cathode of the tube 5 is connected to the anode of the tube 6. The output circuit of the tube 4 comprises the primary winding 7 of a transformer with three secondary windings 8, 9 and 10. The winding 8 supplies the amplified energy to the input circuit of a following amplifying tube, or to a sound reproducing device, whereas the windings 9 and 10 serve to feed the cathodes of the tubes 5 and 6. The device operates as follows: If a determined potential is applied to the points 1 and 2 of the circuit arrangement, this potential will be amplified by the tube 4. The current in the output impedance sets up in the windings 9 and 10 a potential which feeds the cathodes of the tubes 5 and 6. Thus, the feeding of the tubes 5 and 6 is dependent on the current in the output impedance, and, therefore, on the energy to be amplified. The internal resistance of the thermionic tubes varies due to the variation of the heating voltage. A second impedance of variable value is consequently connected in parallel to the input impedance of the tube 4. An increase of the output energy causes a decrease of said variable impedance, and, therefore, a decrease of the potential on the input electrodes of the amplifying tube.

The most favorable operation is obtained when the internal resistance of the tubes 5 and 6 is of the order of magnitude of the further impedance in the input circuit. Since this input impedance is as a rule small relative to the internal resistance of the tubes 5 and 6, there is provided a series resistance 3 which may be adjustable in order to obtain an exact adaptation. Besides, said resistance 3 allows of influencing the intensity of the controlling effect of the device.

It is evident that various small modifications may be made in the circuit arrangement above described, while notwithstanding the desired effect is obtained. Thus, for example, the variable impedance may be connected into any desired input or output circuit of a multi-stage amplifier. When this impedance is included in a circuit in which exclusively flows a pulsatory direct current, one of the tubes 5 and 6 connected in parallel, but contrarily will be sufficient. If the tubes 5 and 6 are indirectly heated, a single winding may be substituted for the transformer windings 9 and 10.

If for the amplifying tubes resistance coupling instead of transformer coupling is utilized, use may be made of the circuit arangement represented in Fig. 2. This circuit arrangement is substantially similar to that shown in Fig. 1, the only difference is that the output transformer is replaced by an ohmic resistance a portion of which is branched for the feeding of the filaments of the tubes 5 and 6 which are represented in this figure as indirectly heated tubes. Besides, it may be advisable to provide the heating current conductors of the tubes 5 and 6 with adjustable resistances in order to obtain the most favorable adjustment of the internal resistance of these tubes. These resistances may also serve to influence the controlling effect. It has been found that the method above described permits obtaining a very satisfactory control of the output energy of an amplifier.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my

invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of my invention as set forth in the appended claims.

What is claimed is:

1. An amplifier comprising an electron discharge tube provided with an input and output circuit, a variable impedance path connected in shunt across the input impedance of said amplifier tube input circuit and including a space discharge device, provided with at least a cathode and anode, and means between the said output circuit and said path for controlling the electron emissivity of said device in accordance with the flow of current in said output circuit whereby the total input impedance of said amplifier is adjusted.

2. An automatic volume control arrangement for an amplifier provided with an input circuit and an output circuit, said arrangement comprising a diode having its anode connected to the grid of said amplifier tube, and its filament connected to the cathode of said amplifier tube, and means for coupling the filament of the diode solely to the amplifier anode circuit whereby the diode filament is energized in accordance with variations in the amplifier anode circuit current.

3. An automatic volume control arrangement for an amplifier provided with an input circuit and an output circuit, said arrangement comprising a diode having its anode connected to the grid of said amplifier tube, and its cathode connected to the cathode of said amplifier tube, and means for coupling the cathode of the diode to the amplifier output circuit in such a manner that the diode cathode is energized in accordance with variations in the amplifier output circuit current and a second diode having its cathode connected to said amplifier grid and its anode connected to said amplifier cathode, and means for coupling the second diode cathode to the amplifier output circuit in a manner similar to the coupling to said first diode cathode.

4. An automatic volume control arrangement for an amplifier provided with an input circuit and an output circuit, said arrangement comprising a diode having its anode connected to the grid of said amplifier tube, and its cathode connected to the cathode of said amplifier tube, means for coupling the cathode of the diode solely to the anode circuit of said amplifier tube whereby the diode cathode is energized in accordance with variations in the amplifier anode circuit current, and a variable resistor connected in the grid side of said amplifier input circuit.

5. An amplifier circuit arrangement comprising a device for controlling the output energy, a variable impedance, comprising two tubes connected in parallel but contrarily, bridged across the amplifier input circuit, and means for heating the filaments of said two tubes in accordance with the intensity of amplified energy.

6. An amplifier circuit arrangement comprising a device for controlling the output energy, a variable impedance, comprising two tubes connected in parallel but contrarily, bridged across the amplifier input circuit, and means including a variable resistor in the amplifier anode circuit for heating the filaments of said two tubes in accordance with the intensity of amplified energy.

7. An amplifier circuit arrangement comprising a device for controlling the output energy, a variable impedance, comprising two tubes of the indirectly heated cathode type connected in parallel but contrarily, bridged across the amplifier input circuit, and means for heating the heater filaments of said two tubes in accordance with the intensity of amplified energy.

8. In combination with an amplifier having an input circuit and an output circuit, said input circuit being adapted for connection to a source of signal energy, an impedance path connected between the grid and cathode of the amplifier in parallel with the input impedance of said amplifier, said path including at least one tube provided with at least an anode and a cathode, and a connection between said tube and the amplifier output circuit for varying the emissivity of the cathode of said tube in accordance with the variation in intensity of the signal current flow in the said output circuit, the relative values of the impedances of said path and said input impedance being so chosen that emissivity variation results in an automatic variation of the signal energy impressed upon said input circuit.

9. In an arrangement as in claim 8, a variable resistor in the said input circuit for adjusting said relative values.

10. In an arrangement as in claim 8, said connection being disposed between the cathode of said tube and the anode circuit of the amplifier, and a second tube connected in parallel with the first tube, the second tube cathode being energized from said amplifier anode circuit.

11. An arrangement as in claim 8, wherein said tube comprises a diode whose anode is connected to the amplifier grid and whose cathode is connected to the amplifier cathode, and said relative values being such that the path impedance is of the same order of magnitude as said amplifier input impedance.

ANTON LEENDERT TIMMER.