

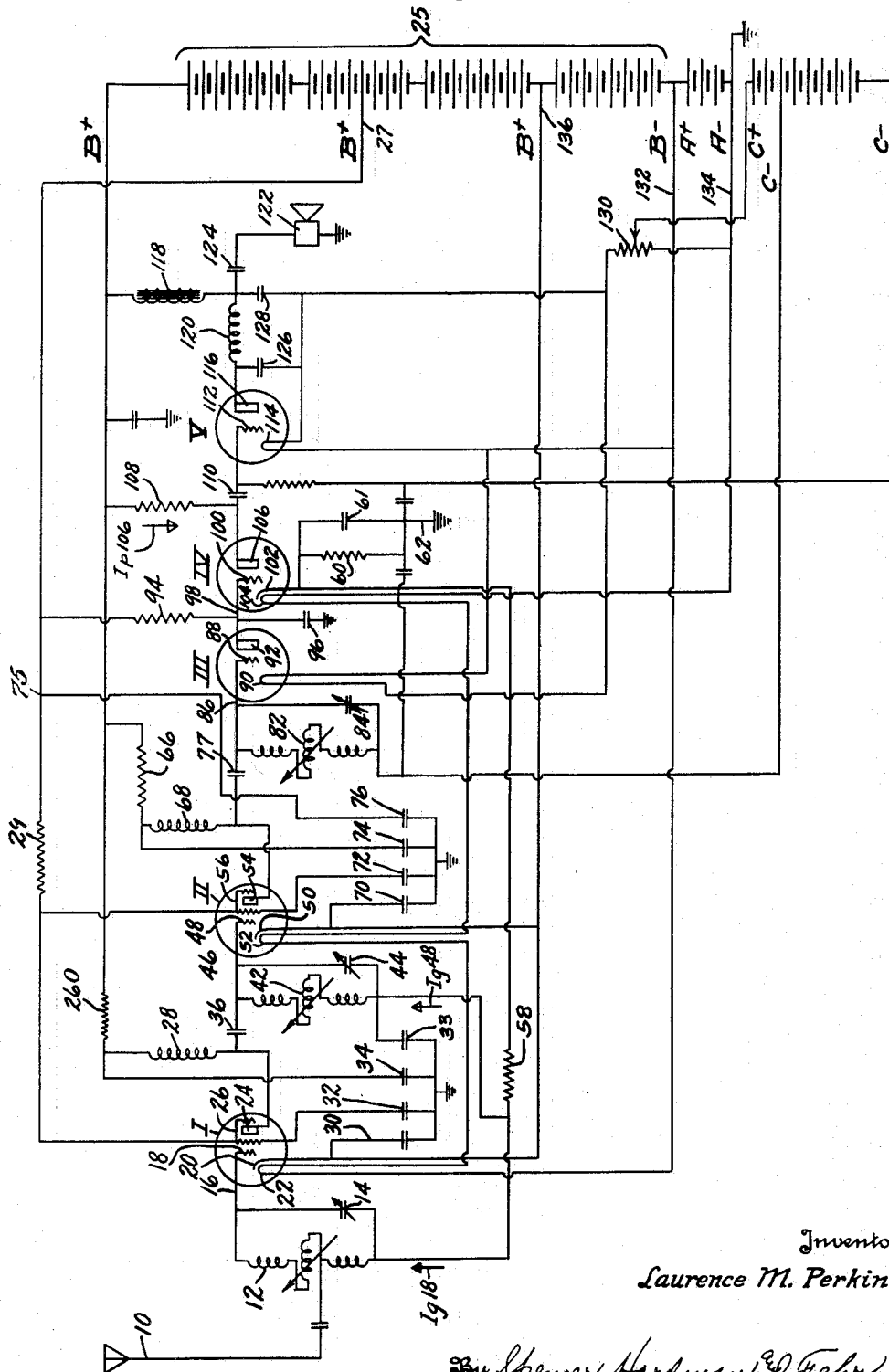
Oct. 31, 1933.

L. M. PERKINS

1,933,148

VOLUME CONTROL

Filed Aug. 15, 1929



Inventor
Laurence M. Perkins

By Spencer, Hardman & Fehr

His Attorneys

UNITED STATES PATENT OFFICE

1,933,148

VOLUME CONTROL

Laurence M. Perkins, Anderson, Ind., assignor
to Delco-Remy Corporation, Anderson, Ind., a
corporation of Delaware

Application August 15, 1929. Serial No. 386,113

9 Claims. (Cl. 250—20)

This invention relates to a radio signal receiving device and more particularly to the automatic control of the volume output of the receiver.

5 In the transmission and reception of radio frequency signals difficulty is encountered due to the well known phenomena referred to as "fading away". Variations in the intensity of the output circuit may also be caused by variation
10 in either the transmitting or in the receiving apparatus.

This is especially pronounced when the filaments of a radio receiver mounted in an automobile are energized from the starting battery.

15 Various methods have been proposed for controlling the volume output. The patent to Espenschied et al. No. 1,447,773, patented March 6, 1923, discloses a mechanically operated device for controlling the volume. The British Patent
20 No. 259,664 discloses an automatic volume control applied to a super-heterodyne receiving set. Wheeler in the January 1928 issue of the proceedings of the Institute of Radio Engineers discusses an automatic volume control operated from
25 the plate circuit of one of the thermionic vacuum tubes.

One object of this invention is to secure a substantially uniform volume output regardless of variation of the incoming signal and of variations
30 in the potential of the A battery. This has been accomplished by providing means for reducing the mean effective potential on a cathode of an electron discharge device as the volume output increases. This cathode is connected to either
35 a preceding or a succeeding control electrode or electrodes or to both preceding and succeeding control electrodes, thereby reducing the effect of the increase in the incoming signal or overcoming the effect of the change in potential across the
40 terminals of the A battery so as to maintain a uniform volume output.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawing:

45 The figure is a schematic diagram illustrating a radio receiver having two stages of radio frequency amplification using screen grid tubes to prevent oscillation, a detector circuit and two stages of audio frequency amplification. Although
50 two stages of radio frequency amplification and
55 two stages of audio frequency amplification have

been disclosed this invention is not limited to the use of this particular arrangement or to the use of this number of stages as more or less stages of radio frequency may be used and more or less stages of audio frequency may be used.

The radio signals received by an antenna 10 are impressed upon a resonant circuit including the variometer 12 in parallel with a condenser 14 which selects a signal for amplification. One terminal of the variometer 12 and the condenser 14 is connected to a control electrode or grid 18 of the electron discharge device or tube I by means of a conductor 16. The tube I comprises besides the grid 18 the cathode 20, the heater element or filament 22, the anode or plate 24 and the screen grid or shield 26. A potential is supplied to the anode 24 by a B battery 25, through a resistance 260 and an inductance 28. The potential on the screen grid 26 is supplied by a tap 27 on the B battery 25 through a resistance 29. Practically all the high frequency currents are prevented from flowing through the B battery by the condensers 30, 32 and 34 serving as by-pass circuits from the cathode 20, the screen grid 26 and a terminal between the resistance 260 and the inductance 28. The resonant circuit comprising the variometer 42 and the condenser 44 is connected through a condenser 33 to ground. The anode 24 is connected to a condenser 36 to a resonant circuit comprising the variometer 42 and the condenser 44 connected by means of a conductor 46 to the control electrode or grid 48 of the electron discharge device or tube II. The tube II includes the cathode 50, the heater element or filament 52, the anode 54 and the screen grid 56. A bias circuit for the grid 48 comprises the resistance 58 and the resistance 60 grounded at 62. The potential on the anode 54 is supplied from the B battery through a resistance 66 and the inductance 68. By-pass circuits for the high frequency A. C. components of the circuit consist of the condensers 70, 72, 74 and 76 connecting the cathode 50, the screen grid 56, a terminal between the resistance 66 and the inductance 68, and a terminal 75 between the resistance 29 and the B battery, respectively, to ground.

The anode 54 is connected by means of a condenser 77 to a resonant circuit comprising the variometer 82 and the condenser 84, each having one terminal connected by means of a lead 86 to the control electrode or grid 88 of the electron discharge device or detector tube III. The detector tube III comprises the usual cathode or filament 90 and the anode 92. The potential on

the anode 92 is supplied from the terminal 27 of the B battery 25 through a resistance 94. A by-pass circuit for the high frequency currents comprises a grounded condenser 96 connected to the anode circuit 92. The anode 92 is connected by means of a conductor 93 to the control electrode or grid 100 of the electron discharge device or tube IV, which comprises the usual grid 100, the cathode 102, the heater element or filament 104 and the anode 106. The potential on the anode 106 is supplied by a B battery through the resistance 108. The bias on the grid 100 is the same as the potential on the anode 92. The anode 106 is connected through a condenser 110 to the control electrode or grid 112 of the electron discharge device or tube V, which comprises the grid 112, the cathode or filament 114 and the anode 116. The potential on the anode 116 is supplied by the B battery through a choke coil 118 in series with an inductance 120. The anode 116 is connected to one terminal of the grounded speaker 122 through a condenser 124 and through the inductance 120. By-pass circuits for the high frequency currents have been provided for this anode circuit which comprises the condensers 126 and 128 connected in parallel from each terminal of the inductance 120 to the cathode 114. The filaments 22, 52 and 104 are connected in series across the terminals of the A battery and the filaments or cathodes 90 and 114 are connected in parallel across the A battery.

It is desirable to have a substantially uniform volume output through the speaker 122 regardless of the volume or intensity of the selected incoming signal and regardless of the varying conditions within the receiver, such as a fluctuation of the A battery voltage. In this receiver an automatic volume control has been provided. From the description supra it can be readily seen that as the direct component of the current through the anode 92 which flows through the resistance 94 increases the potential supplied to the anode 92 decreases. In other words, the potential supplied to the anode 92 is equal to the potential of the terminal 27 which remains substantially constant minus the voltage drop across the resistance 94. Obviously, the voltage drop across the resistance 94 increases as the current through the resistance increases.

The potential supplied to the grid 100 is at all times substantially the same as the potential supplied to the anode 92. This being the case the potential on the grid 100 decreases when the potential on the anode 92 decreases. A decrease in the potential supplied to the grid 100 will cause a decrease in the flow of current from the anode 106 to the cathode 102. The bias on the grids 18 and 48 is supplied by the grid resistances 58 and 60.

The bias or potential supplied to the grids 18 and 48 is substantially equal to the potential on the cathode 102 which decreases as the current flowing from the anode 92 to the cathode 90 increases. In order to supply a more negative potential to the grids 18 and 48 than is supplied to the cathodes 20 and 50, these cathodes have been connected to a terminal 136 of the B battery which supplies the desired potential to the cathodes. Very satisfactory results may be had by using resistance 94 equal to 10 megohms, and each of the resistances 58 and 60 equal to $\frac{1}{4}$ megohm, when 112.5 volts is supplied to the anode 92 and 45 volts is supplied to the cathodes 20 and 50.

A condenser 61 provides a by-pass circuit for the alternating components of the current passing from the anode 106 to the cathode 102. This together with the resistance 58 prevents the alternating components excepting those of a very low frequency of this current from having any effect upon the bias of the grids 18 and 48.

By this arrangement a substantially uniform output is obtained, even though the volume of the selected incoming signal changes and even though conditions within the receiver change. In this modification the volume control is used to control the bias on the preceding grids. This method of automatically controlling the volume output could also be used in controlling the bias on the succeeding grids.

The volume output may also be regulated manually by adjusting the potentiometer 130 which changes the potential or C bias supplied to the grids 88 and 112.

The resonant circuits including the variometers 12, 42 and 82, connected in parallel with the condensers 14, 44 and 84, respectively, may be tuned in unison by mounting the rotors of each of the variometers upon a common shaft. After the rotors have been attached to the shaft each of the resonant circuits may be tuned to the same resonant frequency for a particular setting of the rotors by adjusting the condensers 14, 44 and 84. After these condensers have once been adjusted no further adjustment of the condensers is required, unless the constants of one or more of the resonant circuits are changed as for example, the changing of the tubes. The tuning of course, could be accomplished by other means than here disclosed, as for example, by gang condensers.

A switch, not shown, located in the ungrounded lead extending from the A battery which may be either lead 132 or 134, may be used to open and close the filament circuits. Either lead 132 or lead 134 which does not have the switch may be grounded.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A volume control for a radio receiver having a plurality of amplifiers arranged in cascade, each of said amplifiers having an electron discharge device including a cathode, an electrode, and an anode, comprising in combination, means for reducing the potential with respect to ground on the cathode in a succeeding discharge device as the volume of the selected incoming signal increases and a conductive impedance connecting said cathode to an electrode of a preceding discharge device so as to supply a more negative bias to the electrode thereby maintaining the volume output substantially uniform.

2. A volume control for a radio receiver having a radio frequency amplification circuit, a detector circuit and an audio frequency circuit, each of said circuits having an electron discharge device including a cathode, a control electrode and an anode, said discharge devices being arranged in cascade, comprising in combination, means for reducing the voltage of the cathode of one of the succeeding discharge devices as the volume increases through the preceding discharge device, and a conductive resistance connecting the cathode to the control electrode in a preceding discharge device so as to increase the

bias in the negative direction on said electrode with respect to its cathode as the volume increases in said preceding discharge device thereby tending to maintain the volume output constant.

3. A volume control for a radio receiver having a series of amplification stages, each stage having a discharge device arranged in cascade, said discharge devices including a cathode, an anode, and a control electrode, comprising in combination, a conductor connecting the anode of one of said discharge devices to the control electrode in the succeeding discharge device, means for reducing the potential with respect to ground on said anode as the selected incoming signal increases, thereby reducing the bias on said control electrode, means for reducing the potential with respect to ground on the cathode of said succeeding discharge device as the bias on said control electrode is reduced, and means connecting said cathode to the electrode of another preceding electron discharge device whereby the volume output is maintained substantially uniform as the incoming signals are increased or decreased.

4. A volume control for a radio receiver having a plurality of amplifiers, each of which has an electron discharge device, said discharge device including a cathode, a control electrode, and an anode, some of said discharge devices being arranged in cascade, comprising in combination, means for reducing the potential with respect to ground on the cathode in a discharge device of a succeeding amplifier as the volume of the selected incoming signal increases, and means for connecting said cathode to a control electrode of a discharge device of another amplifier so as to reduce the bias with respect to ground on the control electrode thereby maintaining the volume output substantially uniform.

5. A volume control for a radio receiver having a plurality of amplifiers having each an electron discharge device, each discharge device including a cathode, a control electrode, and an anode, some of said discharge devices being arranged in cascade, comprising in combination, means for varying the potential supplied to a cathode in the discharge device of one of said amplifiers, said means varying said potential with respect to ground inversely to the mean effective volume of the selected incoming signal, and means responsive to the potential supplied to said cathode for varying the potential supplied to the control electrode of another discharge device thereby maintaining a substantially uniform volume output.

6. A signal amplifying device, comprising in combination, a signal amplifying electron dis-

charge device, said electron discharge device including a cathode, an anode and an electrode; a signal current utilization device in the anode circuit, means for varying the potential of the cathode with respect to ground, said means varying said potential as the strength of the incoming signal varies, and a circuit for controlling the attenuation of the amplifying device, said circuit being responsive to said means for varying the voltage so that the attenuation decreases as the incoming signal increases and vice versa.

7. A signal amplifying circuit having a plurality of amplifying stages, each of said stages having an electron discharge device including a cathode, an anode and a control electrode, comprising in combination, a signal carrying circuit intermediate the anode and the cathode of one of said electron devices, a grounded circuit intermediate said anode and said cathode for carrying the continuous current component, said component varying in magnitude as the strength of the incoming signal varies, said second circuit including a resistance in series with said cathode and ground, and means responsive to the change in voltage drop in said resistance for changing the amplification of said amplifying device so as to tend to maintain a constant signal output.

8. A volume control for a radio receiver having a plurality of amplifiers arranged in cascade, each of said amplifiers having an electron discharge device characterized by a cathode, and an electrode, and an anode, comprising in combination, means including one of the said amplifiers for reducing the potential with respect to ground on the cathode in one of said discharge devices as the volume of the selected incoming signal increases, and a conductive impedance path connecting said cathode to an electrode of another discharge device so as to supply a more negative bias to the electrode for maintaining the volume output substantially uniform.

9. A volume control for a radio receiver having a plurality of amplifiers arranged in cascade, each of said amplifiers having an electron discharge device characterized by a cathode, and an electrode, and an anode, comprising in combination, one of said amplifiers affecting a reduction of the potential with respect to ground on the cathode in one of said discharge devices as the volume of the selected incoming signal increases, and a conductive impedance path connecting said cathode to an electrode of another discharge device so as to supply a more negative bias to the electrode for maintaining the volume output substantially uniform.

LAURENCE M. PERKINS.

60

135

65

140

70

145

75

150