

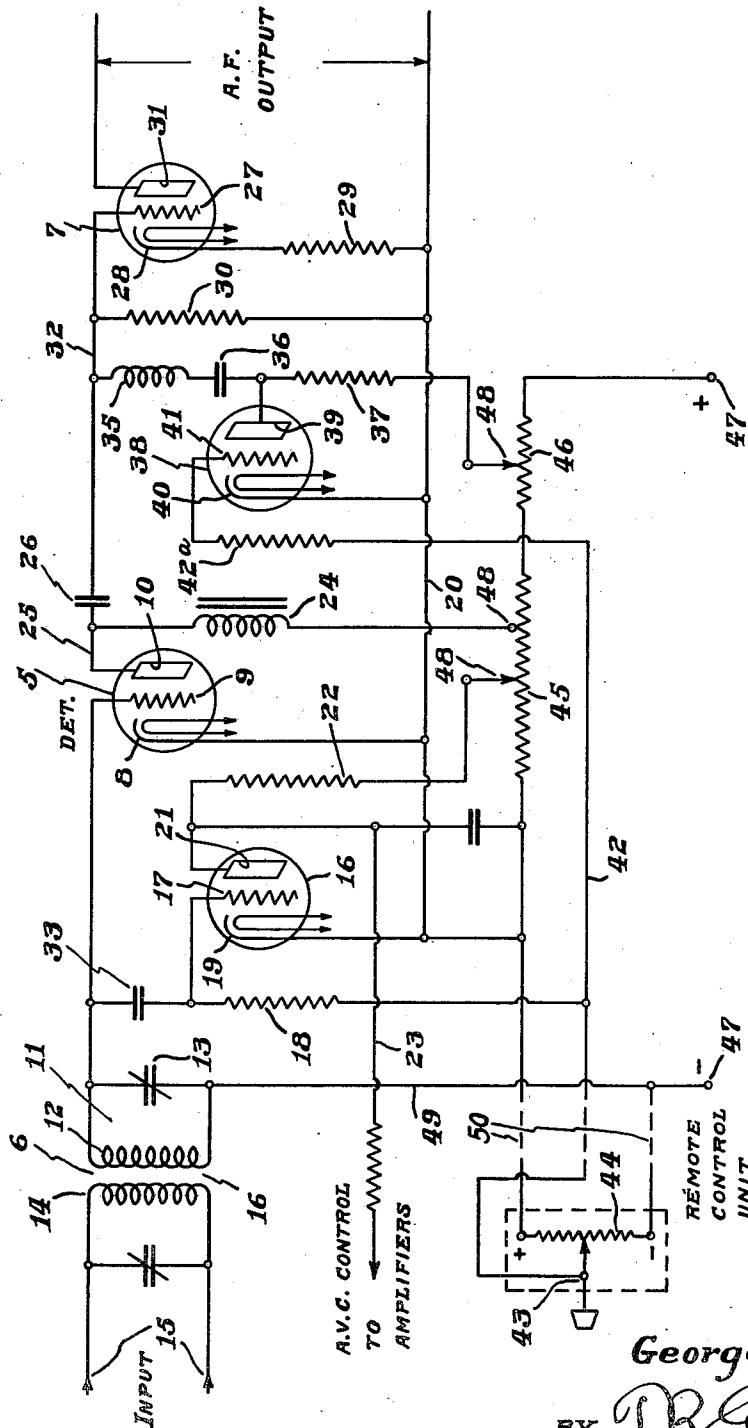
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G. L. BEERS

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RADIO RECEIVING SYSTEM

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INVENTOR:

George L. Beers

BY *J. R. Goldberger*

ATTORNEY

UNITED STATES PATENT OFFICE

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RADIO RECEIVING SYSTEM

George L. Beers, Collingswood, N. J., assignor to
Radio Corporation of America, a corporation
of Delaware

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The present invention relates to radio receiving and amplifying systems, and more particularly to remote volume control means for such systems.

5 In providing remote control means for radio receiving systems, it is desirable to control the gain or signal amplitude by suitable volume control means within the apparatus, without extending the signal conveying circuits to the remote control points. This may be provided by motor control means wherein only the motor control circuits are extended to the remote control points. Also, in the event that the volume control means for a radio receiving system is applied to high frequency circuits, the high frequency amplifier tubes may be controlled directly by varying the biasing potentials thereon through extension of the biasing potential circuits, without extending the signal conveying circuits.

20 However, with the advent of compensated volume control systems, wherein the control of volume is acoustically compensated at various sound levels, remote volume control systems heretofore employed are found to be not practical either because of complicated circuits, or because of cost, the latter disadvantage being particularly characteristic of remote motor control circuits for radio apparatus.

30 A form of acoustically compensated volume control circuit is shown and described in the patent to Stevenson 1,788,035 for Volume control circuits. In such systems, as the audio frequency signal amplitude is reduced by suitable means such as a volume control potentiometer in the audio frequency circuit, the audio frequency transmission characteristic is altered whereby signals in certain frequency ranges are more highly attenuated, thereby to compensate for the effect upon the ear of sounds at lower volume levels. For acoustical compensation of volume control means, it is necessary that the signal amplitude be maintained at a predetermined level before compensation is applied for the reason that definite compensation may not otherwise be provided for each sound level. This normally requires a substantially "flat" automatic volume control means preceding the compensated volume control circuit as a part of the system.

Ordinarily, to provide the type of acoustically compensated volume control above referred to at a remote point without resorting to motor control, necessitates operating certain conductors in a remote control cable at high audio frequency potentials with respect to ground. The capacity between conductors in such a cable may be great

enough to produce an appreciable effect upon the fidelity characteristic of the receiving system. An electric motor control system with only the motor circuits extended to operate the compensated volume control system, while practical, is at the same time costly.

It is, therefore, an object of the present invention to provide an improved remote volume control system for radio receiving apparatus and the like which is adapted to provide tone control or acoustic compensation without resorting to complicated circuits involving loss of fidelity or motor control means.

It is a further object of the present invention to provide an improved tone compensated remote control system for radio receiving apparatus and the like, which involves simple control circuits adapted to be extended to any length to remote control points without extending the signal conveying circuits.

It is also an object of the invention to provide a tone or acoustically compensated volume control system for radio receiving apparatus and the like which is adapted for remote control operation.

In accordance with the invention, a gain control circuit including a gain controlling tube or electric discharge device and a tone control network including a second control tube or electric discharge device are provided with a common grid bias control circuit which may be extended to a remote control point in connection with a bias potential control device such as a potentiometer resistor. By this means, both control tubes are controlled simultaneously, whereby, as the volume or signal amplitude is reduced, the desired tone compensation is provided.

In a practical embodiment of the invention, the automatic volume control tube of a radio receiving system is arranged to be controlled simultaneously with a tube having its anode circuit connected with a tone compensating network in the audio frequency portion of the receiving system. The biasing potential on both tubes is then varied simultaneously through a common extensible control circuit thereby eliminating the use of motors and motor control circuits and the extension of signal conveying circuits.

The invention will, however, be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing, the figure is a circuit diagram of a portion of a radio receiving system provided

with an acoustically compensated remote volume control system embodying the invention.

Referring to the drawing, the signal conveying circuit of a radio receiving system is represented by way of example by an electric discharge device or detector tube 5 which receives signals through an input coupling transformer 6, and which in turn is coupled through audio frequency coupling means, hereinafter described as an audio frequency electric discharge amplifier device or tube 7.

In the present example, the detector device 5 may be considered as the second detector of a superheterodyne receiving system and is provided with a cathode 8, a control grid 9, and an anode 10. The control grid 9 is connected with a tuned input circuit 11 comprising the secondary 12 of the transformer 6 and a suitable tuning condenser 13, whereby it is tuned to a predetermined intermediate frequency. The primary winding 14 of the transformer is connected with the output circuit 15 of an intermediate frequency amplifier (not shown).

A volume control electric discharge device or tube 16 as an automatic volume control means is provided with a control grid 17 connected with the signal input circuit through a coupling condenser 33 and a grid leak resistor 18. The tube is further provided with a cathode 19 connected with the cathode 8 through a lead 20, and an output anode 21 in circuit with which is provided an anode impedance or resistor 22. Automatic volume control potentials for the preceding amplifier (not shown) is taken through an automatic volume control lead 23 from the impedance 22.

Automatic volume control systems of this character are well known and understood and, accordingly, further description is not believed to be necessary. The tube or electric discharge device 16, however, represents any suitable electric discharge control means for controlling the signal amplitude of the receiving system. For purposes of the invention, the usual automatic volume control tube is well suited for this purpose. The detector device 5 is coupled to the amplifier device 7 through an audio frequency choke coil 24 in the output anode circuit 25 and a coupling condenser 26, to the input electrode or control grid 27 of the amplifier tube 7. The latter is provided with a cathode 28 having a self-bias resistor 29 in circuit therewith to the negative end of which the control electrode or grid 27 is connected through a suitable grid bias supply resistor 30. The output anode for the device 7 is indicated at 31 and may be connected to any suitable apparatus (not shown) for further amplifying or utilizing the audio frequency signals.

The audio frequency signal conveying circuit may be represented by leads indicated at 32 and 20 between the detector device and the audio frequency amplifier device 7. Across this circuit is connected a tone control network which is to be utilized for acoustic compensation for the output signals currents of the system. Any suitable point, however, in an audio frequency system or signal receiving system may be chosen for the application of tone controlling means for acoustic compensation. It is preferably connected, however, across a portion of the audio frequency circuit.

By way of example, the tone control network comprises an inductance 35, a condenser 36, and a relatively high impedance element such as a resistor 37, in series. The impedance element 37 is connected in parallel with the anode impedance

of an electric discharge control device or tube 38 the anode of which is indicated at 39 and the cathode of which is indicated at 40. The cathode is connected with the cathodes 8 and 19 through the lead 20. The impedance device 37 is a resistor, in the present example, providing a plate load impedance for the device 38 and is sufficiently high in resistance value and the internal impedance of the device 38 is also sufficiently high to prevent the tone controlling network from normally being effective across the circuit.

The condenser 36 and choke coil or inductance 35 provide a series resonant circuit tuned to a predetermined frequency range preferably between 1,000 and 1,500 cycles, or any desired frequency range in the audio frequency band about which tone compensation is desired as the signal volume is varied. The effect of the tone control network is varied by means of the device 38 the control grid of which is connected to a control or grid bias supply lead 42 with the control grid 17 of the automatic volume control tube 16. The control lead 42 is variably connected to a source of biasing potential through the movable contact 43 of a potentiometer device 44 across which is maintained a difference of potential having a polarity as indicated. A current limiting resistor 42a is included in the lead 42.

In the present example, the potentiometer resistor 44 is included in circuit at the negative end of a voltage divider resistor having two sections 45 and 46 in series across supply potential terminals indicated at 47. The anode circuits of the device 5, 16 and 38 are connected as indicated to tap points 48 on the voltage divider resistor, certain of the tap points as indicated, being preferably variable for adjustment of the potential values for proper operation of the automatic volume control tube 16 and the tone control tube 38.

With the arrangement shown, it will be seen that as the contact 43 of the potentiometer 44 is moved, the portion of the resistor 44 included between the cathode 19 and the control grid 17 of the volume control tube 16 and also between the cathode 40 and the control grid 41 of the tone control tube 38 will be varied, thereby simultaneously varying the biasing potential applied to the said control tubes.

The circuit connections are such that the variation of biasing potential causes the automatic volume control tube to increase the negative biasing potential applied to the automatic volume control circuit 23, and thereby reduce the signal amplitude or output volume of the system, while at the same time, the plate to cathode impedance of the tone control device 38 is decreased as the grid 41 becomes more positive. In this manner the tone control network becomes more effective across the audio frequency channel 32—20 to reduce the audio frequency amplitude within the range of the series resonant circuit. Therefore there is provide a reduction in the signal amplitude or volume and automatically a corresponding predetermined acoustic compensation.

It will be seen that the potentiometer device 43—44 may be of the simple resistance type having a single movable contact, and that it may be connected in circuit by merely extending the control or bias supply lead 42 and circuit connection leads indicated at 50 to any suitable point remote from the remainder of the receiving apparatus.

It will further be seen that since the bias control circuit conveys only direct current or direct biasing potentials, no signal currents are con-

veyed externally of the apparatus by this system.

The detector device may be of any suitable type. In the present example, it is of the anode bend type and, accordingly, the grid 9 is connected through the secondary 12 and a supply lead 49 with a point more negative than the cathode 8 such as the negative potential supply terminal 47, whereby the potential drop through the volume control potentiometer 44 may, at the same time, be utilized to supply the bias potential to the detector device 5 thereby eliminating the use of other potential drop producing means for that purpose.

It will be seen that the control tube 38 functions to reduce the gain of the audio frequency system within a predetermined range such as a mid-range, in the present example, and is controlled by the manual volume control means for the system which operates to adjust the bias potential applied to the volume control tube 16, which is also the automatic volume control tube of the system. The bias potential of the tone control tube is controlled simultaneously with and by the same means as the volume control tube, whereby in operation the user of the apparatus in which the system is provided obtains proper acoustic compensation by merely adjusting the volume as in the case of apparatus not having the advantage of remote control.

I claim as my invention:

1. Acoustically compensated volume control means for remote control radio receiving systems and the like, comprising a tone control network, an electric discharge tone control tube having an anode circuit connected therein and having a control grid, a volume control circuit, an electric discharge control tube in said volume control circuit, said tube having a control grid for receiving signals and an output circuit providing a gain controlling biasing potential, a control circuit

connected with said grids through which circuit biasing potentials may be supplied to said grids simultaneously, and means in said circuit for simultaneously varying said biasing potentials.

2. Means for remotely controlling the volume in a signal transmission circuit with acoustic compensation, including in combination, a remote variable resistance device, a direct current bias control circuit including said device as a bias potential controlling element therein, and volume and tone control electric discharge tubes for said signal transmission circuit connected with said control circuit to receive variable biasing potentials therefrom.

3. In a radio receiver, the combination with means for receiving, detecting and amplifying a signal modulated carrier wave, of means for altering the tone of the reproduced signal, means providing automatic volume control potentials for said receiver, each of said means including an electric discharge control tube having a control grid, a cathode and an anode, a common grid bias control circuit for said tubes, and means in said circuit for simultaneously varying the grid bias applied to said tubes through said circuit.

4. In a radio receiver, the combination with means for receiving, detecting and amplifying a signal modulated carrier wave, of means for altering the tone of the reproduced signal, means providing automatic volume control potentials for said receiver, each of said means including an electric discharge control tube having a control grid, a cathode and an anode, a common grid bias control circuit for said tubes, means in said circuit for simultaneously varying the grid bias applied to said tubes through said circuit, and means connected in series with the tone altering means for varying the effect of said tone altering means upon the reproduced signal.

GEORGE L. BEERS.