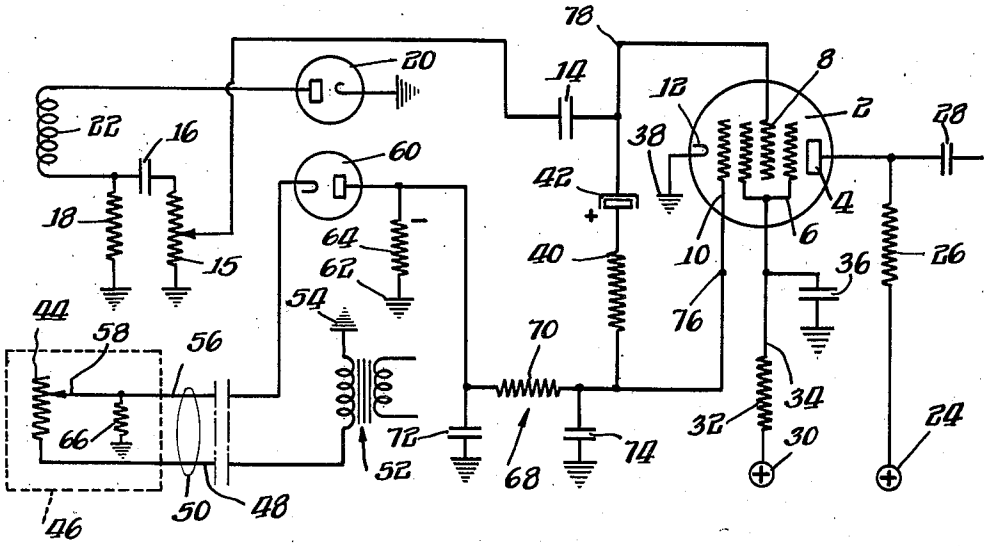
Dec. 10, 1940. W. J. SCHNELL 2,224,582

RADIO RECEIVER

Original Filed May 21, 1938



INVENTOR.
William J. Schnell
BY: Cox & Moore
ATTORNEYS.

Patented Dec. 10, 1940 2,224,582

UNITED STATES PATENT OFFICE

2,224,582

RADIO RECEIVER

William J. Schnell, Berwyn, Ill., assignor to Electrical Research Laboratories Inc., Chicago, Ill., a corporation of Illinois

Original application May 21, 1938, Serial No. 209,170. Divided and this application January 9, 1939, Serial No. 249,932

5 Claims. (Cl. 250—20)

This invention relates to a radio receiver and more particularly to a volume control circuit for the receiver.

It is an object of this invention to provide means for controlling the volume of a radio receiver from a truly remote point.

The well known Bowden cables for mechanically operating the volume control resistor of a radio receiver are of course unsatisfactory for any substantial distance or for home use. It has heretofore been proposed to control the volume of the receiver from a remote point but such electrically operable remote volume control devices as have been suggested have been either complex in character or unsatisfactory because of the inherent capacity existing between the wire leads to the remote point, which inherent capacity has heretofore produced distortion or "howling" in the sound reproduction circuits of the receiver.

It is therefore a further object of applicant's invention to provide a simple, inexpensive and highly efficient electrically operable remote volume control preferably capable of energization or energized by the alternating current supplied to the radio receiver.

Other and further objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawing showing a schematic diagram of a remote volume control constructed in accordance with the invention.

The present application is a division of the application filed by William J. Schnell and Eugene W. Masters, as Serial No. 209,170, filed May 21, 1938.

A volume control circuit constructed in accordance with the principles of the invention is schematically shown in the drawing. A thermionic vacuum tube 2, having a plate 4, a screen grid 6, an injector grid 8, a control grid 10, and a cathode 12, may constitute the first stage of audio-amplification of the radio receiver. The injector grid 8 is connected through a condenser 14 to the coupling and volume control resistor 15. The resistor 15, together with a condenser 16, couples the input of the tube 2 to the output resistor 18 of a diode rectifier or detector 20. The signal currents are supplied to the diode 20 by means of the secondary winding 22 of an interstage transformer connecting the radio frequency or intermediate frequency amplifier to the detector. Plate current is supplied to the tube 2 from the power supply terminal 24 through the resistor 26 and the interstage coupling condenser 28 connects the signal output of the tube 2 to the input of the next succeeding stage of amplification. The screen grid 6 is connected to the usual and suitable source of positive potential represented by the terminal 30, a resistor 32 being connected in series in the screen grid lead 34 and a shunting condenser 36 being connected to the lead 34 and to ground.

The cathode 12 may be heated in any desired and customary manner and may be grounded as at 38 or otherwise connected to the free end of the coupling and volume control resistor 15. The control grid 10 is connected to the injector grid 8 through a resistor 40 and bias cell or source 42 having its negative terminal connected to the injector grid and its positive terminal connected to the resistor 40.

A volume control resistor 44 is mounted at a remote point or station 46. One end of the remote volume control resistor 44 is connected by a lead or wire 48 of a cable 50 extending between the remote station 46 and the radio receiver. At the radio receiver the wire 48 is connected to one end of a secondary winding 52 of the power supply transformer, the other side of this secondary being preferably grounded as at 54. The voltage supplied by this secondary is preferably of the order of twenty-four volts. The other wire 56 of the cable 50 connects the adjustable tap 58 of the volume control resistor 54 to the cathode of a diode rectifier 60. The plate of this diode rectifier is connected to ground at 62 through a resistor 64. At the remote station the wire 56 and the adjustable tap 58 are connected to ground through a resistor 66. A filter 68, comprising a resistor 70 and shunting condensers 72 and 74, connects the diode rectifier 60 to the control grid 10 of the amplifier tube 2.

The operation of this circuit is substantially as follows. The signal input rectified by the diode 20 is impressed on the injector grid 8 of the tube 2 and the value of this voltage is controlled by the volume control resistor 15 which is located in the receiver and is operated by the knob on the front of the receiver. The remote volume control resistor 44 determines the value of the alternating current voltage impressed by the resistor 66 on the input of the diode rectifier 60 and in turn determines the value of the direct current bias voltage impressed by the resistor 64 on the control grid 10 of the tube 2. The filter 68 filters the voltage impressed on the control grid. It will be apparent that by decreasing the value of the alternating current voltage across the resistor 66, the resistance 44 being increased,

the direct current voltage or negative bias potential impressed by the resistor 64 on the control grid 10 and the injector grid 8 will be correspondingly decreased to thereby effect a decrease in the bias of the grids and a consequent increase in the amplification power of the tube 2. The output signal volume of the tube 2 will therefore be increased. An increase in the alternating current voltage across the resistor 66 will correspondingly effect a decrease in the volume of the output signal of the tube 2.

If desired, the input signal may be impressed on the control grid and the injector grid used primarily for remote volume control purposes by merely connecting the injector grid 8 to the point 76 and the control grid 10 to the point 78.

It will be seen from the description of the drawing that the invention contemplates a strikingly simple, electrically operable remote volume control in which the capacity of the leads connecting the receiver to the remote point has substantially no effect upon the speech reproduction circuits of the receiver.

If desired, the diode rectifiers 20 and 60 may be replaced by a single, double diode rectifier or detector but in this case some slight capacity coupling may exist between the remote volume control circuit and the signal input circuit. However, in actual test, this intercoupling has been found insufficient to exert any substantial effect on the speech reproduction circuits of the receiver. In an actual installation, a 6L7 tube was employed for the tube 2 and a 6H6 double rectifier tube employed for the tubes 20 and 60. The values of the resistances employed were as follows. 15, 1 megohm; 18, .5 megohm; 26, 150,000 ohms; 32, 200,000 ohms, 40, 1 megohm; 64, 1 megohm; 66, 6,000 ohms; and 70, 1 megohm. The values of the condensers were as follows. 14, 16 and 28, .02 microfarad. The condenser 72 was .1 microfarad; the condenser 74 was .5 microfarad and the condenser 76 was of the usual value employed with a screen grid.

Changes may be made in the form, construction and arrangement of the parts without departing from the spirit of the invention or sacrificing any of its attendant advantages, and the right is hereby reserved to make all such changes as fairly fall within the scope of the following claims.

The invention is hereby claimed as follows:

1. In combination, a radio receiver having an audio-amplifier comprising a thermionic tube having a plate, a cathode and a pair of control grids, a detector for supplying rectifier signal voltages to said amplifier, means including a volume control means located at the receiver for connecting the output of said detector between one of said control grids and said cathode, a source of alternating current at said receiver, a rectifier in said receiver, a resistor in the output circuit of said rectifier, a filter connecting said output resistor to the other control grid of said audio-amplifier tube, a variable resistor at a remote point, a fixed resistor connected to said variable resistor, a cable connecting the radio receiver to said variable resistor, said cable comprising a wire connecting the source of alternating current to said variable resistor and a wire connecting said fixed resistor to the input of said rectifier whereby said variable resistor controls the biasing voltage impressed by said rectifier on said other control grid thereby to vary the volume of the signal in the output of said audio-amplifier tube.

2. A volume control for a radio receiver having an amplifier and a power supply source in the receiver independent of the signal currents flowing through the amplifier, said volume control comprising a first impedance at the receiver and connected to said amplifier to supply biasing voltages to said amplifier, a second impedance at a point remote from the receiver, and means connecting the power supply source in series with said second impedance and connecting said first impedance across said second impedance, said connecting means including manually adjustable means at the remote point controlling the flow of current from said source through said second impedance for determining the value of the biasing voltage impressed by the first impedance on said amplifier.

3. A volume control for a radio receiver having an audio-amplifier having a power supply source in the receiver independent of the currents flowing through the amplifier, an impedance at the receiver and connected to said amplifier to supply biasing voltage to said amplifier, a resistor at a point remote from the receiver, a circuit connecting said resistor in series with said source, means connecting said impedance across the resistor to derive control voltages therefrom determined by the current flowing through said resistor at the remote point and manually adjustable means in said circuit for determining the value of the current flowing from the source through said resistor.

4. In combination with a radio receiver having an amplifier and a source of alternating current in the receiver, a rectifier in the receiver, an impedance in the receiver, an impedance at a point remote from the receiver, means connecting the impedances in series with the rectifier and the impedance in the receiver to the input of the amplifier to impress a direct current biasing voltage on the input of said impedance, voltage control means at a point remote from the receiver, means connecting said voltage control means in series with the source of alternating current and impedance at the remote point, means for adjusting said voltage control means to vary the alternating voltage across the impedance at the remote point whereby the rectified current through the impedance in the receiver is adjustably controlled to vary the biasing voltage on the input of the amplifier.

5. A volume control for a radio receiver having an amplifier and an alternating current power supply source in the receiver, a rectifier in the receiver, a resistor in the receiver in series with the rectifier and connected to said amplifier to supply a direct current biasing voltage to said amplifier, a resistor at a point remote from the receiver, a circuit connecting the remote resistor in series with the alternating current source, a circuit connecting said rectifier and the resistor in the receiver in series across the remote resistor to derive control voltages therefrom determined by the current flowing through the remote resistor, and an adjustable resistor at the remote point in series with the other resistor at the remote point and the power supply source for determining the value of the alternating current flowing from the source through said other resistor at the remote point.

WILLIAM J. SCHNELL.