July 2, 1940. W. E. GILBERT 2,206,181

REMOTE CONTROL FOR RADIO RECEIVERS

Filed March 14, 1938 3 Sheets-Sheet 1

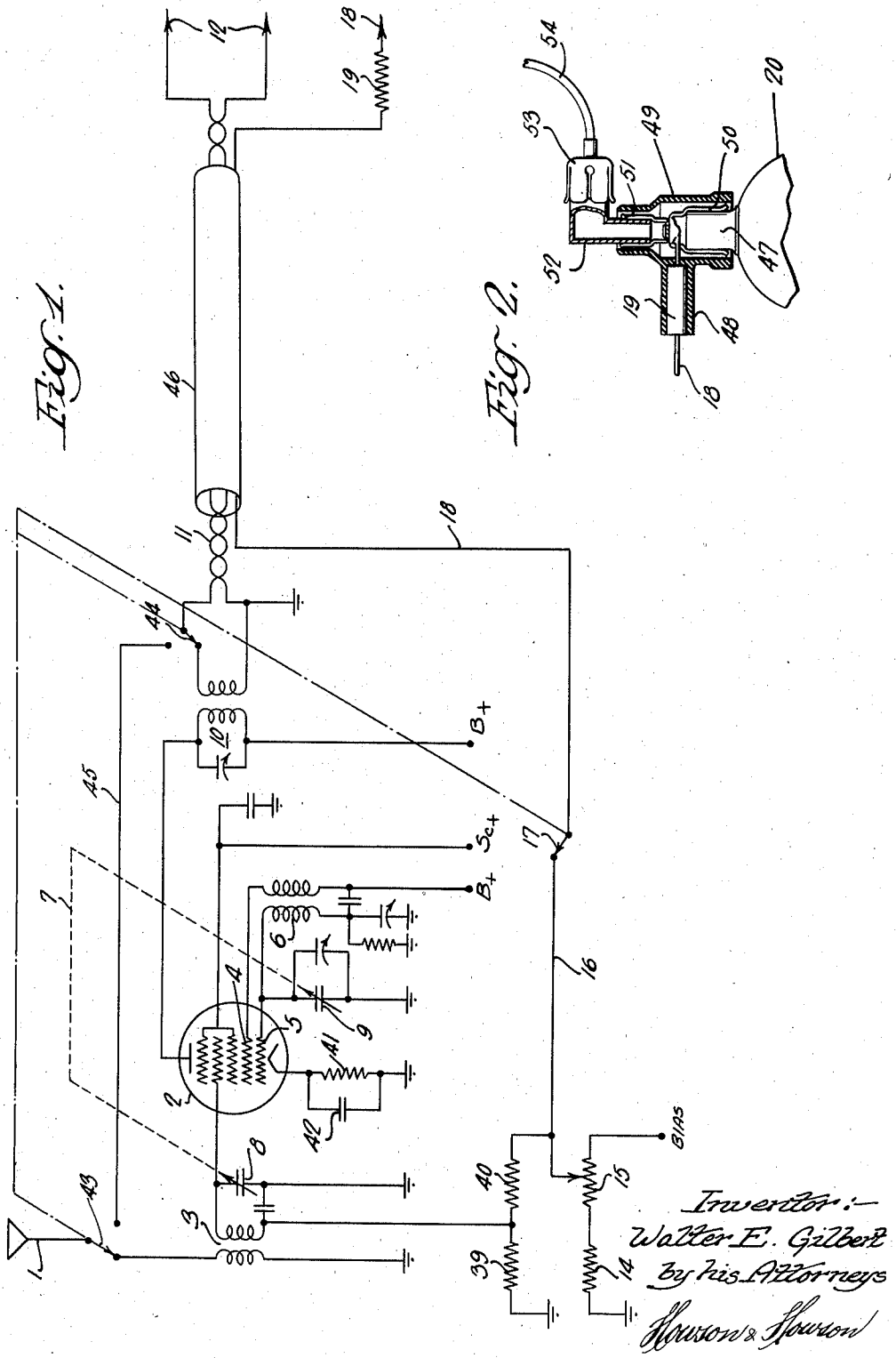


Fig. 1.

Fig. 2.

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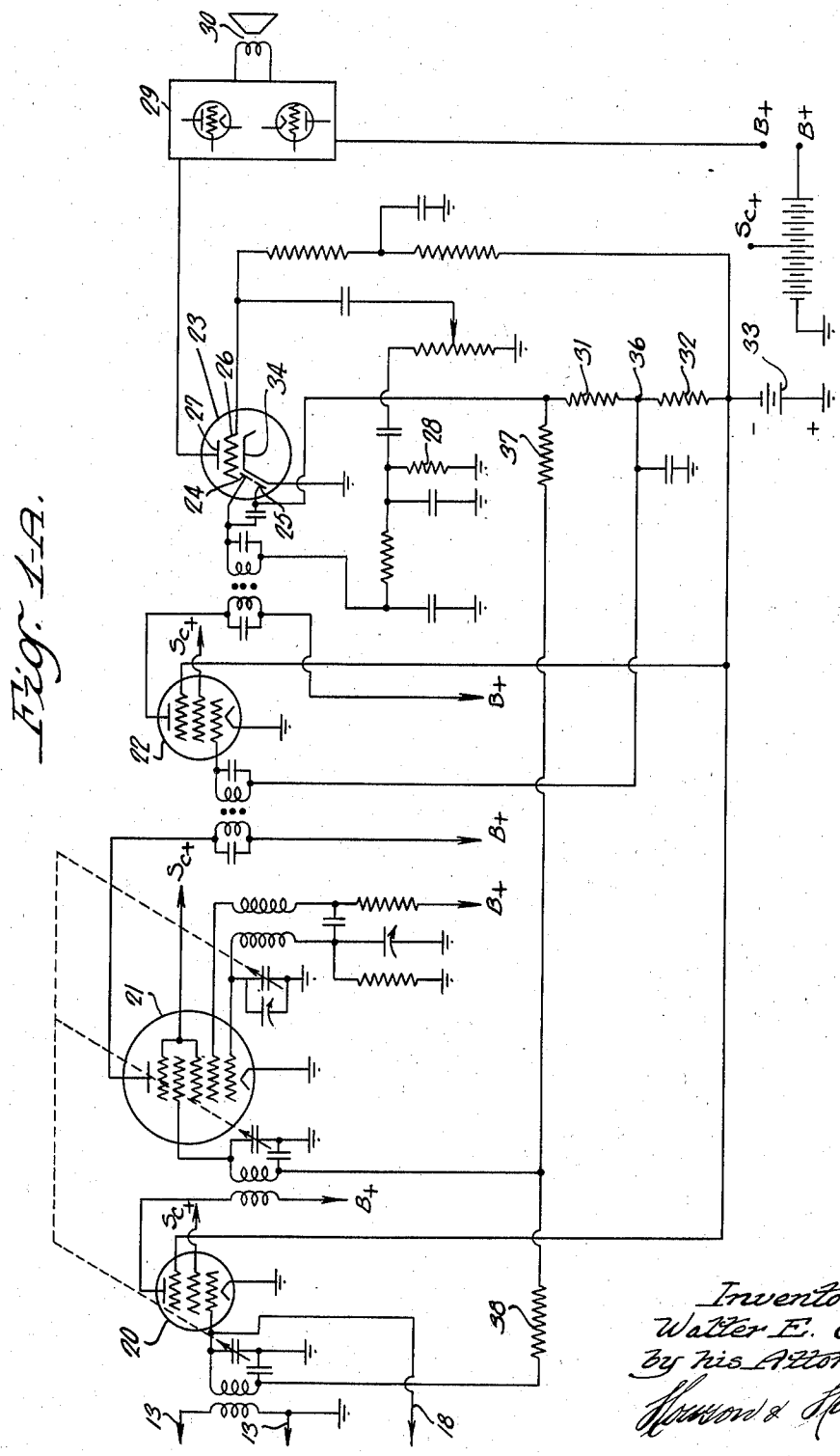


Fig. 1-A.

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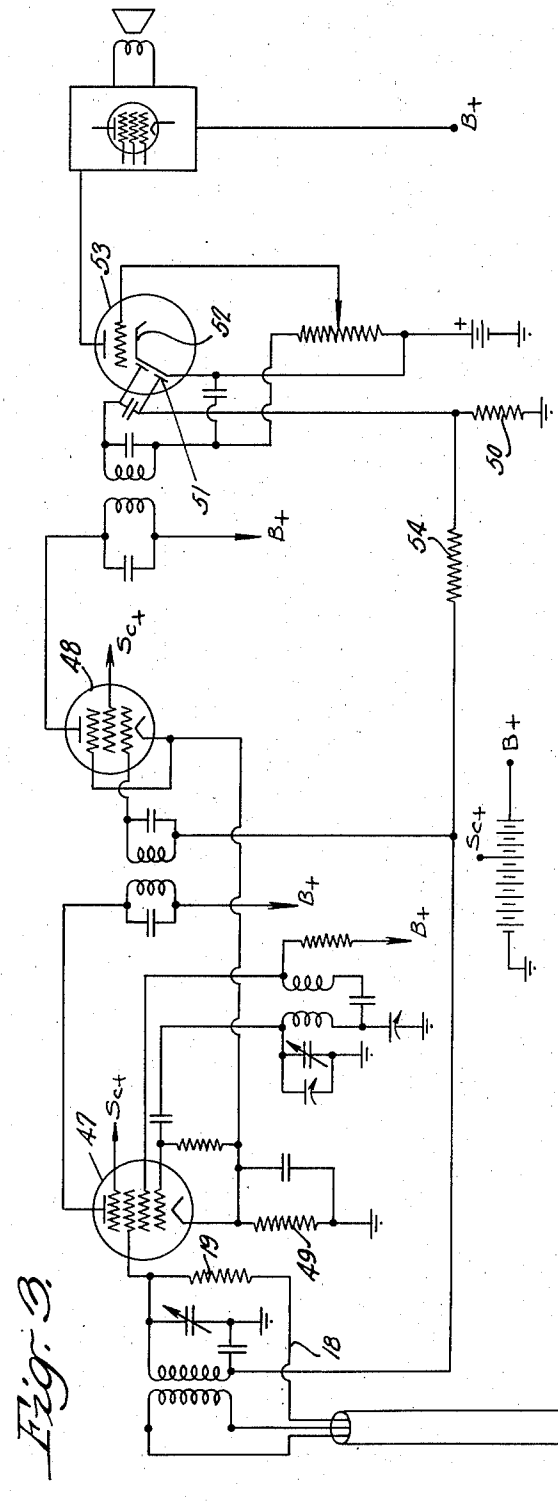


Fig. 3.

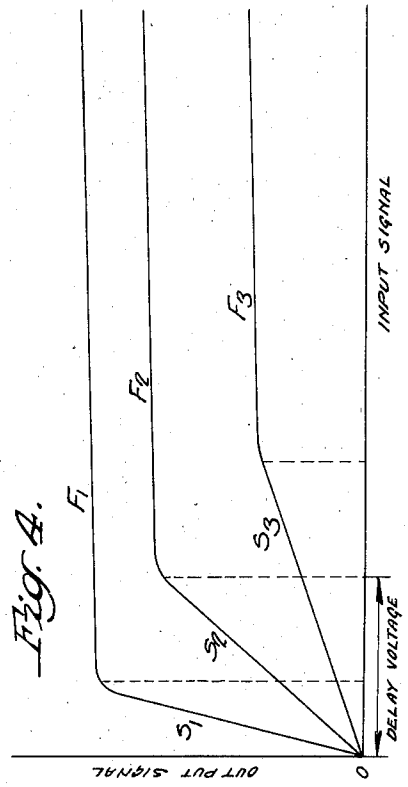


Fig. 4.

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Patented July 2, 1940 2,206,181

UNITED STATES PATENT OFFICE

2,206,181

REMOTE CONTROL FOR RADIO RECEIVERS

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Application March 14, 1938, Serial No. 195,895

14 Claims. (Cl. 250—20)

This invention relates to a remote control unit for use in tuning radio receivers from a distance, and more particularly, to a remote control unit which incorporates a novel means of volume control.

The invention provides means for controlling a radio receiver from a distance, as from across a room, or from an adjacent room. Such an arrangement permitting remote tuning is highly desirable where the operator wishes to maintain complete control of his receiver while comfortably seated or located at a distance therefrom. That the volume level may also be remotely controllable is of particular importance since it permits of an accurate adjustment in accordance with the strength of the signal being received and the distance of the listener from the receiver. It is further desirable that the remote control unit incorporating these features be capable of installation on all types of standard receivers with a minimum of labor and without the necessity of making changes in the receiver circuits.

Preferably the present invention is embodied in a remote control unit of the type employing a frequency converted, including, for example, a tube known in the art as a detector-oscillator. Signals from a suitable antenna may be supplied to the converter through a transmission line. The input section of the converter may then be tuned to any desired signal. In a manner well understood by those skilled in the art, the signal generated by the oscillator section of the converter beats with the desired incoming signal, producing a signal whose frequency equals the sum, or preferably the difference frequency, which may then be transmitted to the receiver. By properly designing the circuit constants, this difference frequency may be maintained substantially constant for any station tuned in. By previously adjusting the tuning of the receiver to this difference frequency, all tuning may be accomplished at the remote point by means of such a converter system.

Owing to the automatic volume control systems generally used at present, ordinary methods of manual volume control cannot be successfully employed to control the volume level of a receiver from a remote point. Attempts to obtain such control solely by reduction of gain at the remote point are impractical, for the highly efficient automatic volume control means, with which modern receivers are equipped, automatically tend to counteract any reduction in applied signal by an equivalent increase in the gain or amplification of the receiver. For example, in receivers so equipped, it is not at all unusual for a 500:1 change in input signal strength to produce less than a 2:1 change in detector output. Under these circumstances, ordinary remote operation would be highly unsatisfactory, for, with a receiver operating at full sensitivity as a result of a weakened signal at its input terminals, the noise pick-up and inherent amplifier disturbance would be highly objectionable, and in extreme cases might be so great as to make reception at low volume levels impossible.

Accordingly, the principal object of this invention is to provide a simple but highly efficient and convenient remote control unit for radio receivers, which embodies novel volume control means free of the defects above-mentioned.

Other objects and other novel features of this invention will be apparent from the following description and the accompanying drawings, in which:

Fig. 1 is a diagrammatic illustration of a remote control unit embodying the invention;

Fig. 1A is a similar illustration of a receiver with which the remote control unit may be employed;

Fig. 2 is a detail sectional view of a connector employed by the invention;

Fig. 3 is a diagrammatic illustration of a modification; and

Fig. 4 shows certain explanatory curves.

Referring now to Figs. 1 and 1A of the drawings, in Fig. 1 there is shown a remote control unit and a transmission line for supplying signals to, and for controlling, a radio receiver such as shown in Fig. 1A. For simplicity the several voltage supply sources are indicated, but not shown in detail. However, the remote control unit, as well as the radio receiver, may include an individual self-contained power supply unit, as well understood. Incoming signals from the antenna 1 are impressed on the input control grid of the converter tube 2 through an antenna transformer 3. Frequency converter tube 2 includes an oscillator anodic grid 4 and an oscillator control grid 5. The oscillator circuits, and the manner in which the incoming frequency and local oscillator frequency are mixed, thereby giving rise to an output frequency equal to the difference of the first two frequencies, are well known to those skilled in the art and detailed description is deemed unnecessary. The secondary winding of transformer 3, and the oscillator grid inductance 6 are tuned by con-

denser gang 7, controlling condensers 8 and 9, and these circuits are so designed as to give rise to a constant difference frequency which is substantially independent of the setting of condenser gang 7. This difference frequency is preferably adjusted to the lower end of the radio receiver's frequency range. A suitable frequency is 530 or 540 k. c., since at present these are little-used channels at the low frequency end of the range receivable on the standard broadcast band of most modern receivers. In the converter plate circuit, there is provided a resonant load circuit 10 which is tuned to this difference frequency. A suitable transmission line 11 is inductively coupled to this load circuit, and the difference-frequency signal, modulated with the modulation of the signal being received, is applied over the transmission line to the input terminals 12 which may be connected to the terminals 13 of the radio receiver (see Fig. 1A). The radio receiver, having been tuned previously to the difference frequency employed, will amplify and detect the modulated difference-frequency signal in the normal manner.

In accordance with the present invention, remote control of the volume level at the receiver is provided by means which produce a reduction in gain both at the remote control unit and in the radio receiver itself. It is furthermore a highly important feature of this invention that the manual volume control means is arranged cooperatively with the receiver's automatic volume control system to provide efficient remote manual volume control and automatic volume control of the received signals. A voltage dividing network, consisting of resistor 14 and potentiometer 15, is connected across a source of bias voltage at the remote control unit. A manually adjustable bias voltage is supplied to lead 16 by means of the movable potentiometer arm. When switch 17 is closed, as shown, the control bias is applied over conductor 18 and through resistor 19 to the control grid of an amplifier tube 20 in the remotely located radio receiver, as will be hereinafter more fully explained. The control bias may be supplied to any amplifier tube in the receiver which normally obtains its bias from the receiver AVC system. Preferably the bias may be applied to the first amplifier in the receiver.

In the drawings the remote control unit, embodying the present invention, is shown in connection with a representative form of superheterodyne radio receiver in a manner which will permit of highly satisfactory remote operation, both as regards station selection and volume level control.

A typical receiver may comprise a tuned radio frequency stage employing a variable mu pentode tube 20 followed by a combination detector-oscillator stage which may include a frequency converter tube 21. The intermediate frequency output of this stage may be amplified by an intermediate frequency amplifier which may employ a variable mu pentode tube 22. The output of this stage may be supplied to a double-diode triode detector and audio amplifier 23. One diode section including diode plate 24 may be used as the second detector, while the other diode section which includes diode plate 25 may be used in the AVC circuit. The triode section including grid 26 and plate 27 may serve as an audio frequency amplifier, amplifying the audio output voltage of the second detector, which appears across the resistor 28. Output stage 29 supplies the signal to loudspeaker 30.

Considering the AVC system, and disregarding the remote control unit for the moment, it will be seen that the path for the rectified current is as follows: from diode plate 25 through resistors 31 and 32, and the bias battery 33 to the point designated as ground, thence to the cathode 34 and back to the diode plate 25. The total AVC voltage will appear across resistors 31 and 32, and a certain fraction of the total AVC voltage may be obtained by tapping off from the junction 36 of the resistors 31 and 32. The AVC diode plate 25 is initially biased negatively by an amount equal to the voltage of battery 33 which provides a suitable "delay" voltage and minimum bias for the several amplifier tubes. The delay obtains because no rectified current will flow in the AVC circuit until the peak voltages impressed on plate 25 exceed the initial negative bias or "delay" voltage. When such a delayed AVC system is employed, no further self-bias is needed for these tubes and their cathodes may all be connected directly to ground. In the receiver of Fig. 1A, all of the developed AVC voltage may be utilized in controlling the gain of the radio frequency amplifier tube and the first detector tube. In the case of the intermediate frequency amplifier only a portion of the developed AVC voltage may be utilized. Resistors 37 and 38 may be used to prevent interaction of the controlled circuits through the common AVC means.

The mode of operation of the system may be understood by reference to Fig. 4. The curve S_1 F_1 indicates the operation when a small bias voltage is supplied by the remote control, while curves S_2 F_2 and S_3 F_3 show the operation for medium and large voltages, respectively. In Fig. 4, the ordinate indicates the detected output voltage as measured, for example, at the detector and the abscissa indicates the input signal from the antenna. It will be understood, of course, that the curves are only qualitative as the tremendous voltage range of the input signal cannot be indicated conveniently on a linear scale.

As the arm of the potentiometer 15 is moved away from the ground end, the D. C. voltage supplied to the receiver will become more negative. The resistors 19 and 37, 38 of the AVC system act as a voltage dividing network and hence the several grids of the receiver amplifier tubes as well as the anode of the AVC detector will become more negative. Hence, the magnitude of the "delay voltage" will increase. Now considering the curve S_1 F_1, for small input signals, insufficient to overcome the delay voltage, the input v. output curve will be given by the portion S_1 of the characteristic curve. Since the amplifier tubes have a small bias, the receiver gain will be maximum and hence the slope of S_1 will be steep. In normal operation the signal at the detector will exceed the delay voltage and hence will cause a rectified voltage to be produced sufficient in magnitude to bias back the amplifier grids to maintain the output at a level F_1 substantially independent of the amplitude of the input signal. If the voltage from the control point is increased, the starting bias on the amplifier tubes is made more negative. Hence the small-signal gain of the receiver is lessened as indicated by the less steep slope of S_2, and even though a larger signal is required at the detector to overcome the "delay" voltage, nevertheless the curve flattens out at a lower output level such as F_2. For larger control voltages the slope becomes even less steep as indicated by S_3 and flattens out at an even lower level F_3. In normal operation, the input signal

amplitude will be well in excess of the knee of the S—F curve and on the F part of the curve. Hence, good AVC action obtains.

It will be further appreciated that the usual and desirable operation of the receiver's automatic volume control system has not been destroyed, and that it will continue to exert a compensating influence upon undesired fluctuations in received signal strength. The effect of the remote manual volume level control is to establish the level about which the AVC system functions, and to determine the maximum gain.

In addition to its function as part of a voltage dividing network, resistor 19 serves additionally as a radio frequency isolating means between lead 18 and the control grid end of resistor 19. Without this resistor the distributed capacitances which are present about lead 18 would serve to detune the resonant circuit associated with the control grid to which connection has been made.

Returning now to the voltage dividing network consisting of resistor 14 and potentiometer 15, it should be noted that the presence of resistor 14 establishes a definite minimum bias which is available to the lead 18 through the potentiometer arm. This is of particular importance in receivers whose controlled tubes are not supplied with some degree of self-bias. The receiver of Fig. 1A illustrates this condition. It will be apparent to one skilled in the art that if the potentiometer arm were permitted to move to a position of zero voltage, the bias effective on the grids of the controlled tubes for a condition of very weak signal might fall so low as to permit of the flow of excessive plate current, with a consequent reduction of tube life, and in addition would bias the grids to an unusable portion of their characteristic where cross modulation obtains.

In order to accomplish a more complete and satisfactory control of the volume level, and to aid the receiver's AVC system in this function, it is provided, in accordance with this invention, that a portion of the bias appearing at the potentiometer arm be employed to control the gain of the frequency converter tube 2. For this purpose there is provided a voltage divider circuit comprising resistors 39 and 40 serially connected between the potentiometer arm and ground. The voltage appearing at the junction of resistors 39 and 40 is applied through the secondary of transformer 3 to the input control grid of frequency converter tube 2. By a proper selection of values for the resistors 39 and 40 it is possible to eliminate any possibility of over-biasing the frequency converter tube 2. On the other hand, to insure that the frequency converter tube is at no time under-biased, there is provided a self-biasing resistor 41 shunted by the by-pass condenser 42.

When tuning a radio receiver by means of the remote control unit the switches 17, 43 and 44, preferably ganged together, are adjusted as shown. When, however, it is desired to operate the receiver in the normal manner, these switches are thrown to their other positions. The result is to disconnect the output winding of the remote control unit from the transmission line 11 and to connect the antenna 1 directly to the transmission line through lead 45, and also to open-circuit the lead 18. It is further desirable that the power supply switch of the remote control unit be operated from the same switch gang.

The cable 46 which extends between the radio receiver and the remote control unit may consist, for example, of a coaxial cable, or a twisted wire line with or without a metallic braid covering. It may include, if it is desired, in addition to the circuits shown, any other circuits which may conveniently be disposed thereon. It may further include, for example, leads for supplying the power supply section of the remote control unit with energy from the usual house lighting circuit. It may further be convenient to locate the lead-in of antenna 1 near the radio receiver, and to connect it to switch 43 by means of a feed line disposed in cable 46. Where this procedure is followed, it is possible to make all external connections to the remote control unit through cable 46, thus providing for increased simplicity and portability.

In Fig. 2, there is shown a novel connector by means of which the conductor 18 and resistor 19 may be removably connected to the grid cap of tube 20. The grid cap is shown at 47 on the top of the tube. The resistance element 19 is disposed in a hollow tubular extension 48 of an insulating socket housing 49. Within this housing there are sockets 50 and 51 which are connected together and to resistor 19. One socket receives the grid cap while the other receives the adapter 52. The usual grid clip 53 is placed over the adapter. Thus the conductor 18 together with resistor 19 and usual input conductor 54 are removably connected to the grid cap 47.

The connector and adapter are constructed so that they may be used with tubes having different sized grid caps, of which there are generally two sizes. By reversing the connector and adapter, placing socket 51 on the grid cap and placing the larger end of the adapter 52 in the socket 50, the device may be used with tubes having smaller grid caps.

It will be seen that the invention thus provides for the connection of the remote control unit to the receiver without changing or disturbing the receiver connections. By merely connecting the conductors 12 to the input terminals of the receiver, removing the grid clip of tube 20, and making the removable connections shown in Fig. 2, the remote control unit may be easily connected to the receiver.

In an experimental remote control unit using a type 6A8G tube as a frequency converter, the following values were found to be satisfactory:

Resistor 39=333,000 ohms
Resistor 40=250,000 ohms
Resistor 14=5,000 ohms
Potentiometer 15=25,000 ohms
Resistor 19=2,000,000 ohms
Resistor 41=200 ohms

It was found that the type 6A8G tube could be operated with normal rated voltages, or with very considerably reduced voltages, since a gain in the remote control unit is not ordinarily desirable. Typical values for the resistors in the AVC system of the receiver shown in Fig. 1A are as follows:

Resistor 38=50,000 ohms
Resistor 37=1 megohm
Resistor 31=1 megohm
Resistor 32=⅓ megohm

Referring now to Fig. 3, there is shown a somewhat different form of radio receiver wherein the controlled tubes are self-biased by means of resistors in the cathode circuits. In the particular form chosen for illustration, bias for both the detector-oscillator tube 47 and the interme-

diate frequency amplifier 48 is obtained by means of the voltage drop across a single resistor 49 which is common to the cathode circuits of both tubes. The normal AVC voltage is developed across the resistor 50 which is connected between AVC diode plate 51 and ground. A desirable delayed AVC action is obtained by placing a small positive bias, or delay voltage on the cathode 52 of the double diode-triode tube 53. When the remote control unit is in operation the voltage effective in controlling the gain of tubes 47 and 48 will have some value between the AVC voltage developed across resistor 50 and the control voltage appearing on lead 18. The magnitude of this voltage is dependent upon the relative magnitudes of the resistors 19 and 54 which form a voltage divider serially disposed between the two control voltages.

In general, operation will be similar to that already outlined in connection with the explanation of Figs. 1 and 1A. The chief difference occurs in the reception of weak signals. In Fig. 3 when the remote control unit is not in use, and for a condition where signals are less than the minimum required to produce operation of the receiver's AVC system, the control grids of the tubes 47 and 48 are at ground potential, and the effective bias is only that which is developed across the resistor 49. In this condition, sensitivity of the receiver is at a maximum. Now when using the remote control unit with this receiver it would be most advantageous to so design the bias supply of the remote control unit that the voltage brought out by lead 18 could be reduced to zero and thus permit the control grids to fall to ground potential, thereby securing the maximum receiver sensitivity. However, for reasons already pointed out in connection with Fig. 1, it would be distinctly disadvantageous to permit lead 18 to fall to zero bias where there is any possibility that the remote control unit might be used in conjunction with a receiver of the general form shown in that figure. Therefore, the minimum negative bias may preferably have a value greater than zero but not so large as to appreciably reduce the sensitivity of receivers of the form shown in Fig. 3. A minimum negative bias of 1 volt has been found to be satisfactory. This value may be fixed by suitably selecting the magnitude of the resistor 14 of Fig. 1. There is thus provided a remote control unit which can be successfully used in conjunction with practically any standard type of commercial radio receiver for home use.

In a radio receiver constructed according to Fig. 3 both the resistors 50 and 54 had a value of 1 megohm, and the bias across resistor 49 for condition of no signal was about 3 volts.

While certain forms of the invention have been described for purposes of disclosure it will be apparent to one skilled in the art that the invention is by no means limited to the particular circuits herein described, but that modifications may be made without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. A remote control unit for use in connection with a radio receiver having at least one space discharge amplifier including a control grid and an automatic volume control system connected to said control grid, said control unit comprising means for providing a manually variable control voltage source, a radio-frequency isolating resistance having one end connected to said source, and means for directly connecting the other end of said resistance to said grid, whereby the gain of said amplifier may be varied without deleterious effects from the automatic volume control system.

2. A remote control unit for use in connection with a radio receiver having at least one space discharge amplifier including a control grid and cap therefor and an automatic volume control system connected to said control grid, said control unit comprising means for providing a manually variable control voltage source, a radio-frequency isolating resistance having one end connected to said variable voltage source, and means for removably connecting the other end of said resistance to said grid cap, whereby the gain of said amplifier may be varied without deleterious effects from the automatic volume control system.

3. A remote control unit for use in connection with a radio receiver having at least one space discharge amplifier including a control grid and an automatic volume control system connected to said control grid, said control unit comprising means for providing a manually variable control voltage source, a space discharge device having a gain control electrode, means for supplying at least part of said control voltage to said control electrode, a radio-frequency isolating resistance having one end connected to said variable voltage source, and means for directly connecting the other end of said resistance to said grid, whereby the gain of said amplifier may be varied without deleterious effects from the automatic volume control system.

4. A remote control unit for use in connection with a radio receiver having at least one space discharge device amplifier including a control grid and cap therefor and an automatic volume control system connected to said control grid, said control unit comprising means for providing a manually variable control voltage source, a space discharge device having a gain control electrode, means for supplying at least part of said control voltage to said control electrode, a resistance connected to said source, and means for removably connecting said resistance to said grid cap, whereby the gain of said amplifier may be varied without deleterious effects from the automatic volume control system.

5. In a remote volume control system, a radio receiver including a signal amplifier whose gain may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a diode having an anode and a cathode, means for supplying output signal energy from said amplifier to said anode and said cathode, a resistance connected to the anode and cathode of said diode, circuit connections for supplying at least part of the voltage across said resistance to said amplifier to provide a bias for the space discharge device, means for minimizing voltage fluctuations in said bias voltage, a remote control unit, means at said unit for forming a manually variable control voltage source, a second resistance, and circuit connections between said unit and said amplifier for connecting in series relation the said second resistance, at least part of said first resistance, and said control voltage source, the polarity of the control voltage being such that the diode is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases.

6. In a remote volume control system, a radio receiver including a signal amplifier whose gain

may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a diode having an anode and a cathode, means for supplying output signal energy from said amplifier, to said anode and said cathode, a resistance connected to the anode and cathode of said diode, circuit connections for supplying at least part of the voltage across said resistance to said amplifier to provide a bias for the space discharge device, means for minimizing voltage fluctuations in said bias voltage, a remote control unit, means at said unit including a potentiometer and source of unidirectional current for forming a manually variable control voltage source, a second resistance, and circuit connections between said unit and said amplifier for connecting in series relation the said second resistance, at least part of said first resistance, and said control voltage source, the polarity of the control voltage being such that the diode is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases.

7. In a remote volume control system, a radio receiver including a signal amplifier whose gain may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a diode having an anode and a cathode, means for supplying output signal energy from said amplifier to said anode and said cathode, a resistance connected to the anode and cathode of said diode, a low pass filter, circuit connections for supplying at least part of the voltage across said resistance to said amplifier through said filter to provide a bias for the space discharge device, a remote control unit, means at said unit including a potentiometer and source of unidirectional current for forming a manually variable control voltage source, a second resistance, and circuit connections between said unit and said amplifier for connecting in series relation the said second resistance, at least part of said first resistance, and said control voltage source, the polarity of the control voltage being such that the diode is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases.

8. In a remote volume control system, a radio receiver including a signal amplifier whose gain may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a diode having an anode and a cathode, means for supplying output signal energy from said amplifier to said anode and said cathode, a resistance connected to the anode and cathode of said diode, circuit connections for supplying at least part of the voltage across said resistance to said amplifier to provide a bias for the space discharge device, means for minimizing voltage fluctuations in said bias voltage, a remote control unit, means at said unit including a serially connected potentiometer, fixed resistance and source of unidirectional current for forming a manually variable control voltage source, a second resistance, and circuit connections between said unit and said amplifier for connecting in series relation the said second resistance, at least part of said first resistance, and said control voltage source, the polarity of the control voltage being such that the diode is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases.

9. In a remote volume control system, a radio receiver including a signal amplifier whose gain may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a diode having an anode and a cathode, means for supplying output signal energy from said amplifier to said anode and said cathode, a resistance connected to the anode and cathode of said diode, circuit connections for supplying at least part of the voltage across said resistance to said amplifier to provide a bias for the space discharge device, means for minimizing voltage fluctuations in said bias voltage, a remote control unit, including a detector-oscillator space discharge device having a gain control electrode, frequency converter circuits connected to said device, circuit means for supplying heterodyne signals from said unit to said receiver, means at said unit for forming a manually variable control voltage source, a second resistance, and circuit connections between said unit and said amplifier for connecting in series relation the said second resistance, at least part of said first resistance, and said control voltage source, the polarity of the control voltage being such that the diode is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases, and means for supplying at least part of said control voltage to said gain control electrode.

10. In a remote volume control system, a radio receiver including a signal amplifier whose gain may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a diode having an anode and a cathode, means for supplying output signal energy from said amplifier to said anode and said cathode, a resistance connected to the anode and cathode of said diode, circuit connections for supplying at least part of the voltage across said resistance to said amplifier to provide a bias for the space discharge device, means for minimizing voltage fluctuations in said bias voltage, a remote control unit including a detector-oscillator space discharge device having a gain control electrode, self-biasing means for said last-mentioned discharge device, frequency converter circuits connected to said device, means for supplying heterodyne signals from said unit to said receiver, means at said unit for forming a manually variable control voltage source, a second resistance, and circuit connections between said unit and said amplifier for connecting in series relation the said second resistance, at least part of said first resistance, and said control voltage source, the polarity of the control voltage being such that the diode is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases, and means for supplying at least part of said control voltage to said gain control electrode.

11. A remote control unit for use in connection with a radio receiver having at least one space discharge amplifier including a control grid and cathode, and an automatic volume control connection extending between said grid and said cathode, said control unit comprising means for providing a manually variable control voltage source, and means for connecting said source between said grid and said cathode in shunt rela-

tion with said automatic volume control connection.

12. A remote control unit for use in connection with a radio receiver having at least one space discharge amplifier including a control grid and cathode, and an automatic volume control connection extending between said grid and said cathode, said control unit comprising means for providing a manually variable control voltage source, a resistance, and means for serially connecting said resistance and said source between said grid and said cathode in shunt relation with said automatic volume control connection.

13. In a remote volume control system, a radio receiver including a signal amplifier whose gain may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a signal rectifier, means for supplying output signal energy from said amplifier to said rectifier, a load resistance in circuit with said rectifier, connections for supplying at least part of the voltage across said resistance to said amplifier to bias the amplifier according to the signal amplitude, means remote from the receiver for forming a manually variable control voltage source, and connections between said receiver and said source for connecting the source to said amplifier in shunt relation with said resistance, whereby said control voltage is applied to said rectifier, the polarity of the control voltage being such that the rectifier is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases.

14. In a remote volume control system, a radio receiver including a signal amplifier whose gain may be controlled by varying the bias voltage of at least one space discharge device in said amplifier, a signal rectifier, means for supplying output signal energy from said amplifier to said rectifier, a load resistance in circuit with said rectifier, connections for supplying at least part of the voltage across said resistance to said amplifier to bias the amplifier according to the signal amplitude, a detector-oscillator space discharge device having a gain control electrode, located remotely with respect to said receiver, frequency converter circuits connected to said last-mentioned device, circuit means for supplying heterodyne signals from said last-mentioned device to said receiver, means at the remote location for forming a manually variable control voltage source, means for supplying at least part of said control voltage to said gain control electrode to control the gain of said detector-oscillator device, and connections between said receiver and said source for connecting the source to said amplifier in shunt relation with said resistance, whereby said control voltage is applied to said rectifier, the polarity of the control voltage being such that the rectifier is rendered inoperative until the signal energy supplied thereto exceeds a threshold voltage and the gain of the amplifier is decreased by said control voltage as said threshold voltage increases.

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