

June 9, 1936.

L. T. FOWLER

2,043,582

RADIO RECEIVER

Filed Jan. 30, 1934

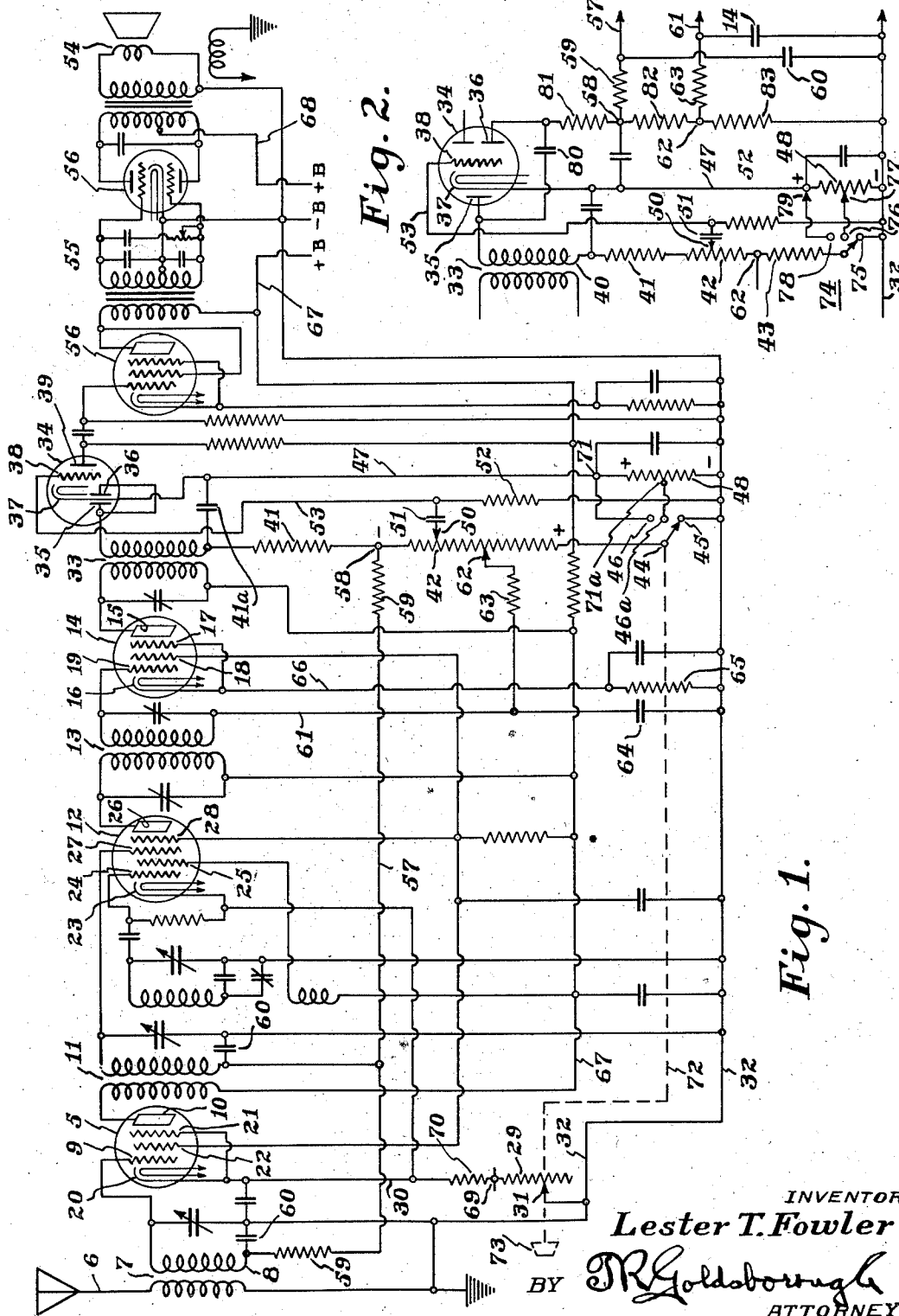


Fig. 1.

Fig. 2.

INVENTOR
Lester T. Fowler
BY *DR Goldborough*
ATTORNEY

UNITED STATES PATENT OFFICE

2,043,582

RADIO RECEIVER

Lester T. Fowler, Oaklyn, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application January 30, 1934, Serial No. 708,956

17 Claims. (Cl. 250—20)

The present invention relates to radio receivers and more particularly to radio receivers of the type having signal responsive control circuits for controlling a condition of operation of the receiver, such as automatic volume control and silent tuning.

In certain types of delayed automatic volume control and silent tuning systems, because of the modulation peaks only being received, distortion on weak signals may occur. It is, therefore, an object of the present invention to provide an improved system for overcoming signal distortion in connection with delayed automatic volume control and for silent tuning systems for radio receivers and the like.

Delayed automatic volume control and response to signals may be obtained by providing in a receiving circuit, means for placing an opposing potential on an electrode of an electric discharge device or tube therein, which potential must be overcome by the signal potential on that electrode before the automatic volume or other control function takes place.

Accordingly, it is also an object of the present invention to provide a receiver which may operate effectively to provide a desired delay action or automatic volume control and/or signal response with a low delay potential or a low degree of delay, thereby to obviate the above disadvantage.

It is a further object of the present invention to provide delayed automatic volume control with minimum distortion on weak signals.

It is also a further object of the invention to provide a degree of delay which will permit silent tuning operation and at the same time will not introduce signal distortion on weak signals.

It is a still further object of the present invention to provide uni-control of the sensitivity and degree of delay of operation of a signal responsive control circuit in a radio receiver.

In accordance with the invention in one embodiment thereof, a signal rectifier circuit is provided in a receiver, including potential drop producing impedance means, from which gain controlling potentials are obtained which vary in accordance with the average signal strength at the receiver. Additional means, preferably manually controllable, are also provided for controlling or reducing the gain or sensitivity of the receiver, preceding the signal rectifier circuit. It has been found that with proper sensitivity control, there may be provided in the signal rectifier circuit, a low voltage fixed source of poten-

tial in opposition to the signal potential applied to the rectifier circuit, for creating a proper delayed response and/or delayed automatic volume control operation.

It is a still further object of the present invention to provide delayed detection in a circuit having a diode electric discharge rectifier or thermionic diode and, in addition, a delayed automatic volume control without appreciable signal distortion, thereby eliminating certain circuit elements in a radio receiver and a separate circuit for the delayed automatic volume control.

It is also an object of the invention to provide the foregoing delayed detection and automatic volume control action with a single diode rectifier of the above named type.

Further, in accordance with the invention, there may be provided selector or switching means for changing the degree of delay or excluding the source of delay potential or a portion thereof, from the rectifier circuit.

Both the sensitivity control and the delay potential selecting means may also be connected for uni-control operation. With this arrangement, on relatively weak signals, when the gain control means is moved to a position of adjustment for maximum gain or sensitivity, the delay potential source may be removed from the signal responsive circuit and the range of sensitivity of the receiver may correspondingly be increased. The invention will, however, be better understood from the following description when taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing,

Fig. 1 is a schematic circuit diagram of a superheterodyne receiver including a preferred embodiment of the invention, and

Fig. 2 is a portion of the circuit of Fig. 1 showing a modification.

Referring to Fig. 1, 5 is a radio frequency amplifier electric discharge device or tube which is supplied with radio signals from an antenna circuit 6 through a suitable tuned coupling transformer 7, the secondary 8 of which is connected with the control grid 9 of the device 5. The device 5 is provided with an output anode 10 which is coupled through a second high frequency coupling transformer 11 to a second electric discharge device or tube 12 which is a combined detector-oscillator, and the latter is in turn coupled through an intermediate frequency transformer 13 with a third electric discharge device

or tube 14 which is an intermediate frequency amplifier, in the present example.

Both of the amplifier devices 5 and 14 are of the screen grid pentode type although other suitable amplifiers may be employed. Like the device 5, the amplifier device 14 is provided with an output anode 15 and, in addition, with a cathode 16, a suppressor grid 17, a screen grid 18 and a control grid 19. Corresponding cathode and suppressor and screen grids for device 5 are indicated respectively at 20, 21 and 22.

The combined detector-oscillator device 12 is provided with a common cathode 23, oscillator grid and plate electrodes 24 and 25, respectively, and an output anode 26 for intermediate frequency signals. The radio frequency input control grid is indicated at 27 and is provided with a suitable screen electrode 28.

As the combined detector-oscillator and amplifier circuits are known and well understood, further description is believed to be unnecessary, since the invention is concerned only with the receiver gain control or amplifying circuits, including the control grids and cathodes.

In the present example, the gain of the receiver is controlled through a variable resistor device 29 placed in the cathode return circuit of one or more of the signal amplifying devices and is shown connected in a cathode circuit return lead 30 for the cathodes 20 and 23 of the radio frequency amplifier device 5 and the combined detector-oscillator device 12. The variable resistor device 29 is provided with a movable tap 31 which is connected to the grounded negative anode potential supply lead for the receiver indicated at 32. The remainder of the bias supply circuit for the amplifier device will be described hereinafter.

The output anode 15 of the intermediate frequency amplifier device 14 is connected through a suitable intermediate frequency coupling transformer 33 with a fourth electric discharge device 34 providing a combined detector-amplifier. This device comprises one or more diode rectifier anodes or plates 35 and 36 associated with a common cathode 37, and amplifier elements also associated with the cathode 37 and comprising a control grid 38 and an output anode 39.

In the present example, the diode plates 35 and 36 are connected in parallel to one end of the secondary 40 of the coupling transformer 33 while the opposite end of the secondary is connected to ground or the return lead 32 through a filter impedance 41, a volume control potentiometer impedance 42, and an arm 44 and one contact 45 of a selector switch, a second contact of which is indicated at 46.

The device 34 thus provides in one envelope an amplifier, and a rectifier of the diode type, and is of the electric discharge type having a common cathode 37. In commercially available tubes, a device of this type is provided with two diode plates 35 and 36 as shown. However, for purposes of the invention in the circuit of the present example, one diode plate is sufficient. With two available, however, they are connected preferably in parallel as shown.

The diode rectifier circuit is completed through a return lead 47 from the cathode through a self-bias resistor 48 to ground or the lead 32. The diode rectifier circuit may then be traced from the secondary 40 to both anodes 35 and 36 in parallel, thence to the cathode 37, through the lead 47 and the self-bias resistor 48 to ground,

returning through the switch contact 45 and the arm 44, thence through the impedances 42 and 41 to the secondary 40.

Signals received on the antenna circuit 6 and amplified through devices 5, 12 and 14 are applied to the rectifier circuit above outlined. The modulation or audio frequency currents and the direct current component of the rectified signals appear across the impedance devices 42 and 41 in the rectifier circuit. The latter impedance device and a by-pass condenser 41a from the diode input circuit to cathode provide a suitable intermediate frequency filter for the output impedance provided by the impedance device 42.

The audio frequency component is variably selectable by a movable potentiometer tap 50 on the output impedance 42. A coupling condenser 51 provides a signal transmitting connection with a coupling resistor or impedance 52 in the control grid circuit or lead 53 of the triode or amplifier portion of the device 34.

Audio frequency signals amplified by the triode, are taken from the output anode 39 and, through suitable coupling means, are applied to a loudspeaker or other suitable output device indicated at 54 through an audio frequency amplifier 55 comprising suitable amplifier devices 56.

The direct current component of the signals in the rectifier circuit is utilized for automatic volume control purposes in connection with the control grids 9, 27 and 19 of the signal amplifier devices preceding the detector circuit. To this end, the impedance element 42 is included in circuit between said grids and their associated cathodes. In the present example, the grids 9 and 27 are connected at the low potential ends of the secondaries of the coupling transformers 7 and 11, and through a lead 57, to a tap point 58 between the impedance elements 41 and 42, 40 suitable filtering impedance and filter condensers being provided for the circuit as indicated at 59 and 60, respectively.

The control grid 19 is connected through the secondary of the transformer 13 with a grid potential supply lead 61 which is connected with a tap point 62 on the impedance 42, a filter impedance 63 and filter condenser 64 being included also in this supply circuit.

It should be noted that the device 14 is also provided with a self-bias resistor 65 in the return lead 66 for the cathode 16. It will also be noted that anode and screen grid potentials for the various devices are obtained from a positive supply lead indicated at 67, except for the device 56 which receives its anode potential from a positive supply lead 68. Since the source of anode and screen grid potentials does not concern the invention the same is not shown, for the purpose of simplifying the drawing.

From the foregoing description it will be seen that there is included in each of the amplifier grid circuits a portion or one or more elements of the rectifier circuit impedance means and an additional fixed bias means such as a self-bias resistor. For the devices 5 and 12 the grid circuit may be traced through the lead 57, and filter impedance 59, the tap point 58, impedance element 42, through the switch to the ground and supply lead 32, thence through the contact 31 and impedance element 29 of the variable resistor to the cathode return lead 32. Likewise, the grid circuit for the device 14 may be traced from the lead 61 through the filter impedance 63 to the tap point 62, thence through a portion of 75

the impedance 43, and through the switch to the ground and negative supply lead 32, returning to the cathode 16 through the self-bias resistor 65 and the cathode return lead 66.

5 With the above described arrangement, a fixed normal bias potential is placed upon the device 14 from the self-bias resistor 65, while a similar bias potential is placed upon the devices 5 and 12 from the variable self-bias resistor 29—31. 10 The value of the resistor 29 is such that it may be varied between limits to establish on the control grids of the devices 5 and 12 controlling potentials for varying the gain of the receiver between desired limits, such as a relatively high 15 gain or sensitivity and a point whereat signals may substantially be cut off.

The tap connections 58 and 62 on the rectifier circuit impedance elements provide, in addition, for signal control of the gain and of detection through controlling potentials which vary in accordance with the average amplitude of the signals applied to the rectifier circuit. In the present example, the arrangement is such that with signals applied to the rectifier circuit, the 25 flow of current therein is in a direction to increase the negative bias on the grids of the various amplifier devices preceding the detector, thereby to reduce the gain, and this connection therefore provides automatic volume control of 30 the amplifier and of the receiver.

The operation of the manual sensitivity or gain control means 29—31 is such that the gain of the receiver is increased as the contact 31 is moved to include less resistance in circuit and 35 in an upward direction, as viewed in the drawing. It will be appreciated that with no signal being received to provide a controlling potential in the rectifier circuit, the bias potential for the devices 5 and 12 is derived wholly from the resistance 29, and in the present example the arrangement is such that the resistance may be reduced by moving the contact 31 toward the extreme or maximum position indicated at 69. 40

In order that the devices 5 and 12 may receive 45 a normal bias when the sensitivity or gain control contact 31 is moved to the position for maximum gain or sensitivity, a fixed bias resistor 70 is also included in series with the resistor 29. The resistor 70 may be a separate device or a part of the potentiometer resistance in construction of the resistance 29 and separated therefrom by a stop at 69, as indicated. 50

The self-bias resistor 48 in the cathode return lead 47 of the device 34 is of such a value that 55 a desired normal bias potential is also provided for the triode amplifier grid 38. It will be noted that the resistor is also included in the rectifier circuit when the switch arm 44 is moved to the contact 45 and that the polarity of the potential drop in the resistor 48 is in a direction to oppose signal potentials appearing on the anodes 35 and 36. In accordance with the invention this opposing potential is caused to be relatively low in value, such for example as one and one-half 60 volts with electric discharge devices at present in use. Therefore, before rectification, that is, signal detection or automatic volume control operation may take place, the signal applied to the diode plates 35 and 36 must exceed the potential drop across the source 43. A delay in the operation of the signal responsive control circuit of the receiver is thereby obtained. This results in a type of operation known as silent tuning since the detector does not respond when the receiver 70 is tuned off from a carrier wave, and then re-

sponds only to signals or carrier waves which are sufficiently strong to overcome the delay potential.

As is well known, silent tuning is desirable for the reason that there are no noises or other sounds emitted by the loudspeaker while tuning between carrier waves. When using a relatively high delay potential, as has been employed in previous receivers, it often occurs that only the peaks of the modulation are sufficient to overcome the high delay potential and therefore distortion results. 10

With a relatively low delay potential, such as from 1½ to 3 volts, appreciable delay and therefore silent tuning may be obtained if proper control of the sensitivity or gain of the receiver is 15 also provided in conjunction therewith, as in the receiver of the present example.

It will be appreciated that silent tuning is possible only in connection with carrier waves which provide a stronger signal than the noise level at the location of the receiver. The variable sensitivity or gain control means is, therefore, provided to adjust the sensitivity or gain to any given noise level so that silent tuning may be obtained off any carrier wave which is strong 25 enough to be received above the noise level to which the receiver is thus adjusted.

There is also further provided means such as a selector switch for changing the degree of delay to provide silent tuning even with a high 30 degree of sensitivity, provided the noise level is sufficiently low. In the present example, the switch contact 46 is connected with a point on the self bias resistor 48 or source of delay potential such that when the arm 44 is moved 35 thereto, a substantial reduction in the delay potential is provided in the rectifier circuit. In the present example, the contact 46 is connected with the positive terminal 71 of the self bias resistor 48. Therefore, it will be seen that when the arm 44 is connected with the contact 45, with this arrangement, no delay potential is included in the rectifier circuit, and rectification and automatic volume control operation will both be obtained immediately upon reception of signals. 45

An operating connection may be, and preferably is, provided between the sensitivity or gain control device 29—31 and the switch, whereby the delay operation is obtainable throughout the range of operation of the sensitivity or gain control device, and at a selected position such as the extreme position for maximum sensitivity or gain, the switch is operated to remove, reduce or otherwise change the degree of delay. 50

Although it may be separate, in the present example the movable contact 31 is mechanically connected with the switch arm 44, as indicated by the dotted line connection 72, and provided with a common manual operating device such as a knob 73, whereby when the contact is moved 60 to the position 69, the switch arm 44 is then moved to the contact 46. Likewise, when the contact 31 is again returned from the extreme position 69 the switch is again operated to move the arm to the contact 45 to restore the normal 65 delayed detection and automatic volume control operation.

It will be seen that when the position of maximum sensitivity is utilized for extremely weak signals, the means for changing or reducing the 70 delayed detection is extremely advantageous for the reason that extremely weak signals may not be of sufficient strength even though amplified, to overcome completely the small delay potential except in the peaks of the modulation, and may 75

therefore cause distortion, which is eliminated when the switch is operated to remove the delay potential.

Briefly summarizing the foregoing, when the slider or contact 31 on the resistor 29 reaches the straight or fixed portion 70 at the stop point 69, the initial fixed bias provided by the potential drop in the resistor section 70 provides for maximum sensitivity combined with automatic volume control through the automatic bias supply resistor or impedance 42. At the same time, the switch arm 44 is moved from the contact 45 to the contact 46 thereby throwing out or removing the delay action in the diode rectifier circuit by connecting the diode circuit to cathode around the cathode or self bias resistor 48. This renders the circuit more sensitive for reception in certain localities where signals are weak although, by eliminating the delay action, the off-carrier noise is somewhat increased.

Intermediate delay potentials may be obtained if desired by providing other contact points on the switching means and other tap connections therefor on the delay potential source. One other such tap connection is indicated at 71a with a switch contact 46a therefor.

With this arrangement the arm 44 may be moved to the contact 46a to change the delay potential to an intermediate value for permitting undisturbed signal reception with a certain degree of delay less than maximum.

Operation of the switch means by the sensitivity or gain control means may be provided to select the tap 46a when the sensitivity control contact 31 is moved to or through an intermediate position before reaching the extreme position at 59.

It may be and often is desirable to provide delayed automatic volume control operation throughout the sensitivity range of the receiver while at the same time providing means for changing the degree of delay in the detector or other tube circuit of the receiver. A circuit of this character applied to the detector circuit of Figure 1 is shown in Figure 2, to which attention is now directed. In this figure the same reference numerals are used to indicate like parts as are provided in Figure 1.

In this figure it will be seen that the diode rectifier plates 35 and 36 of the device 34 are arranged for functioning in separate circuits, the rectifier plate 35 being connected in the detector circuit, comprising the secondary 40 of the input transformer 33 and the series connected impedance elements 41 and 42. The cathode 37 is provided with a cathode return lead 47 in which is located the self bias resistor 48.

A three point selector switch 74 in circuit with the diode plate 35 provides a connection through a contact 75 with the ground lead 32 and the negative end of the self bias resistor or potential source 48, a second connection through a contact 76 with an intermediate tap 77 between the terminals of the resistor 48, and a third contact 78 provides a second tap 79 on the resistor 48 more adjacent to the positive end thereof.

It will be seen that by adjusting the switch selectively to one of the contacts 75, 76 or 78 various potentials may be inserted in series with the detector circuit opposing the signal potential of the diode plate 35 to various degrees. By providing a proper number of contacts and tap points on the source 48, various degrees of delay may be obtained in the operation of the detector.

It will also be seen that by moving the switch to the contact 76 and then operating the movable contact 77 along the resistor 48, the delay may be gradually changed from zero at the positive end of the resistor to a maximum at the negative end. However, one or two points of control have been found to be sufficient, as may be provided by a tap switch such as that shown in 74, or in Fig. 1 and in the matter of cost is better adapted for commercial receiver work in connection with a variable sensitivity control device.

A separate automatic volume control circuit is provided in connection with the second diode rectifier plate 36 which is coupled to the input transformer 40 through a coupling condenser 80. The circuit is completed through suitable impedance elements 81, 82 and 83 in series with the ground lead 32 and the self bias resistor 48 to the cathode return lead 47. Bias potentials controlled by the signal amplitude are then obtained for the amplifier control leads 57 and 81 through the filter impedances 59 and 63 as shown, provided with tap connections on the impedance elements, 81, 82 and 83, as indicated at 58 and 62.

It will be seen that with this arrangement, the delay potential set up across the self bias resistor 48 is applied to the diode rectifier plate 36 and provides a fixed delay potential for the automatic volume control system regardless of the adjustment of the detector delay.

It will be noted that in both embodiments of the invention, the receiver is provided with a volume control device 42-59 in addition to the sensitivity control device 29-31. This is for the reason that the sensitivity or gain of the receiver may thereby be adjusted independently of the receiver volume adjustment to provide sufficient gain to overcome the delay action of the detector with signals which are above the noise level. Stated in other words, the sensitivity may be adjusted toward maximum to a point where the noise level is reached, at which point weaker signals than the interference at noise potential at the receiver location are not permitted to be received because of the delay action of the detector.

With this adjustment for maximum sensitivity at the particular location on the receiver, the volume is then adjusted wholly by means of the volume control device 42-59. With this adjustment the noise level and signals below it are not received and silent tuning is obtained between those stations which are received.

By employing means for changing the degree of delay of the receiver in response to signals, in conjunction with means for varying the degree of sensitivity or gain of the receiver, and separate volume control means, a greater range of sensitivity is obtainable while retaining the advantages of delayed response and automatic volume control. In addition, distortion on weak signals is prevented by removing the delay potential when adjusting the receiver for maximum sensitivity or gain. Thirdly, a certain permissible delay voltage, three volts or less, is utilized whereby serious distortion on all signals is prevented. Fourthly, the variable sensitivity control permits a low delay voltage to be used without sacrificing the advantages of silent tuning flowing from the use of a delayed detector action.

It may also be said that the combination of a variable sensitivity or gain control in conjunction with means for changing the degree of delay of the receiver, preferably at the detector, and automatic volume control of the amplifier, per-

mits a saving of at least one amplifier device as normally required in systems heretofore known.

The circuit arrangement provided in accordance with the invention permits effective delayed detection and obviates certain disadvantages inherent in systems for accomplishing a similar result through other means. For example, a system in accordance with the invention obviates the necessity for a high degree of delay or a relatively high delay potential in the signal receiving circuit with its undesirable inherent distortion caused by signals in a critical average value carrying modulation back through the threshold value of the detector.

This disadvantage may be overcome to a certain degree by separating the automatic volume control and detector functions. However, this involves a further complication of the circuits and additional circuit elements including, in certain instances, an additional amplifier circuit for the silent tuning or noise operation control.

By employing a relatively low degree of delay or a relatively low delay potential in a signal diode rectifier circuit of the thermionic or electric discharge type, the low delay action increases greatly the number of signal channels which may be received without distortion when the threshold value of the detector is reduced to substantially a minimum. Therefore, delayed detection and delayed automatic volume control operation may be obtained in a signal receiving system in connection with a signal diode rectifier without appreciable signal distortion when employed in conjunction with a sensitivity or gain control means independently and separately operable with respect to the diode rectifier circuit.

The additional means, provided by the switching control of the degree of delay or delay potential whereby the said delay potential is automatically thrown out or removed from the circuit, when the sensitivity or gain control is adjusted to give maximum signal amplification permits tuning in weak signals that otherwise would be received only with distortion in connection with delayed detection or automatic volume control.

By providing the circuit arrangement and rectifier circuit as hereinbefore described, effectively delayed signal detection without distortion is made possible.

I claim as my invention:

1. In a radio receiver, the combination of means providing silent tuning, and means for conjointly adjusting the initial point of response of said silent tuning and the sensitivity of said receiver, whereby said silent tuning means is effective without signal distortion throughout a predetermined range of signal strength variations.

2. In a radio receiver, the combination of means providing delayed signal response with a low degree of delay, means for independently varying the sensitivity to provide a degree of signal strength greater than the degree of delay, and means for reducing the degree of delay in response to an increase in the sensitivity to a predetermined maximum degree.

3. In a radio receiving system having means providing delayed signal reception, the combination therewith of means for changing the degree of initial delay therein, and means for conjointly varying the sensitivity of said receiving system in predetermined mutual relationship.

4. In a radio receiving system having means providing delayed signal reception, the combination of means for changing the degree of delay therein, means for controlling the sensitivity of

said receiving system, and common means for operating said delay changing and sensitivity control means.

5. In a radio receiver, the combination of a signal rectifier circuit, an amplifier for supplying signals to said rectifier circuit, means for establishing a delay potential in said rectifier circuit, means for controlling said last named means, and gain controlling means for said amplifier connected with said last named means for uni-control operation therewith.

6. In a radio receiver, the combination with a detector, of silent tuning means providing a relatively low degree of delay in the response of said detector to signals of relatively low average amplitude, an amplifier for supplying signals to said detector, means for conjointly controlling the gain of said amplifier and changing the degree of delay of said detector.

7. In combination, a signal amplifier, a signal rectifier, means for impressing amplified signals on said rectifier, means for impressing an opposing potential upon said rectifier, said potential being of a relatively low value with respect to impressed signal potentials, variable means for changing the gain of said amplifier, and means for changing said opposing potential simultaneously with the operation of said last named means for substantially maximum gain.

8. In combination, a signal amplifier, a signal rectifier, means for impressing amplified signals on said rectifier, means for impressing an opposing potential upon said rectifier, said potential being of a relatively low value with respect to impressed signal potentials, variable means for changing the gain of said amplifier, means for changing said opposing potential simultaneously with the operation of said variable means for substantially maximum gain, means in circuit with said rectifier providing gain controlling potentials for said amplifier, and means in circuit with said rectifier for deriving signal potentials therefrom, said last named means being independently variable with respect to said first named variable means, for controlling the volume of signal output from said rectifier.

9. In a radio receiving system, the combination of a signal rectifier device comprising a cathode and two diode plates associated therewith, means including a signal amplifier for impressing signals on each of said diode plates, an automatic volume control circuit for said amplifier connected with one of said plates, a detector circuit connected with the other of said diode plates, means for applying selected delay potentials to said detector circuit, means for controlling the gain of said amplifier independently of said automatic volume control circuit, and means for operating said potential selecting and gain controlling means in predetermined mutual relationship.

10. In a radio receiving system, the combination of a signal amplifier, means for varying the gain of said amplifier, an electric discharge device having a cathode and a second electrode associated therewith to provide a signal rectifier, a signal receiving circuit for impressing amplified signals on said rectifier between the cathode and said electrode, potential drop producing impedance means in said circuit, means for passing current through a portion of said impedance means to provide a delay potential on said rectifier, means for controlling the value of said delay potential applied to said circuit in accordance with variations in gain, means for deriving from said impedance means gain controlling potentials for

said amplifier, and independently variable means for deriving rectified signal potentials from said impedance means whereby the output volume of said system may be varied independently of said amplifier gain, a control electrode and an anode electrode associated with said cathode to provide an electric discharge amplifier device, means for impressing said last named potentials on said control electrode, and means for deriving low frequency currents from said anode.

11. In a radio receiving system, the combination of a signal amplifier, means for varying the signal gain through said amplifier whereby the sensitivity of the receiving system may be adjusted, a diode rectifier device of the electric discharge type having a cathode and an anode electrode associated therewith, a signal receiving circuit connected with said amplifier and with said diode rectifier to impress amplified signals on said rectifier through said circuit, an impedance device in said circuit, means providing a low delay potential of substantially fixed value on said anode electrode, means connected with the first named means for varying the degree of delay with variations in signal gain, means for deriving from said impedance device gain controlling potentials for said amplifier, and variable means for deriving rectified signal potentials from said impedance device.

12. In a radio signal receiving system, the combination of a detector of the electric discharge diode rectifier type, a receiving circuit for said detector including an impedance device and a low voltage source of delay potential for said detector, a signal amplifier for impressing signals on said circuit, means for deriving from said impedance device automatic volume control potentials for said amplifier, separate means for controlling the gain of said amplifier, volume control means for said system, and means for controlling said delay potential in response to operation of said gain control means at a predetermined point of operation.

13. In a radio receiving system, the combination of a combined diode rectifier and signal amplifier of the electric discharge type having a common envelope containing a diode rectifier plate, an anode electrode, a control electrode, and a cathode common to said electrodes, potential drop producing impedance means in circuit between said cathode and control electrode for providing biasing potential for said control electrode, means for impressing signal potentials on said diode plate, means for selecting a delay potential for said diode plate from said impedance means, and means for controlling the sensitivity of said receiving system controllably conjointly with said delay potential selecting means.

14. In a radio receiving system, the combination of a combined diode rectifier and signal amplifier of the electric discharge type having a common envelope containing a diode rectifier plate, an anode electrode, a control electrode, and a cathode common to said electrodes, potential drop producing impedance means in circuit between said cathode and control electrode for providing biasing potential for said control electrode, means for impressing signal potentials on said diode plate, means for selecting a delay potential for said diode plate from said impedance

means, means for controlling the sensitivity of said receiving system controllably conjointly with said delay potential selecting means, means for deriving rectified signals from said impedance means, said means being variable to control the volume for said receiving system, means for impressing said derived signals on the control electrode, and a signal output circuit connected with the anode electrode.

15. In a radio signal receiving system, the combination of an electric discharge amplifier device including a cathode and at least one diode rectifier plate associated therewith, signal amplifying means for supplying amplified signals to said first named device and including a second electric discharge amplifier device having a cathode and a control grid and a circuit for coupling said device with the diode plate of said first named device, selector means for impressing opposing potentials on said plate of values relatively low with respect to the average amplitude of signal potentials impressible thereon from said amplifying means, potential drop producing impedance means connected between the cathode and said plate of said first amplifier device, circuit means for connecting at least a portion of said potential drop producing impedance means between the cathode and control grid of the second amplifier device whereby a signal responsive biasing potential is applied to said amplifier from said impedance means to control the gain thereof, and independent gain controlling means for said amplifier including a manually variable impedance in circuit between said cathode and grid.

16. In a radio signal receiving system the combination of an electric discharge amplifier device including a cathode and at least one diode rectifier plate associated therewith, a second electric discharge amplifier device having a cathode and a control grid, means for impressing signals to be rectified on the diode plate of said first named device, selector means for impressing opposing potentials on said plate of values relatively low with respect to the average amplitude of signal potentials impressible thereon through said system, potential drop producing impedance means connected between the cathode and the plate of said first amplifier device, circuit means for connecting at least a portion of said potential drop producing impedance means between the cathode and control grid of the second amplifier device whereby a signal responsive biasing potential is applied to said amplifier from said impedance means to control the gain thereof, independent gain controlling means for said amplifier including a manually variable impedance in circuit between said cathode and grid, and means providing an operating connection between said selector means and said independent gain controlling means, whereby said selector means is operable therewith at predetermined points.

17. In a radio receiving system, the combination of means providing delayed signal reception, means for reducing the degree of delay in signal reception, and means for simultaneously increasing the sensitivity of said receiving system in predetermined mutual relationship.