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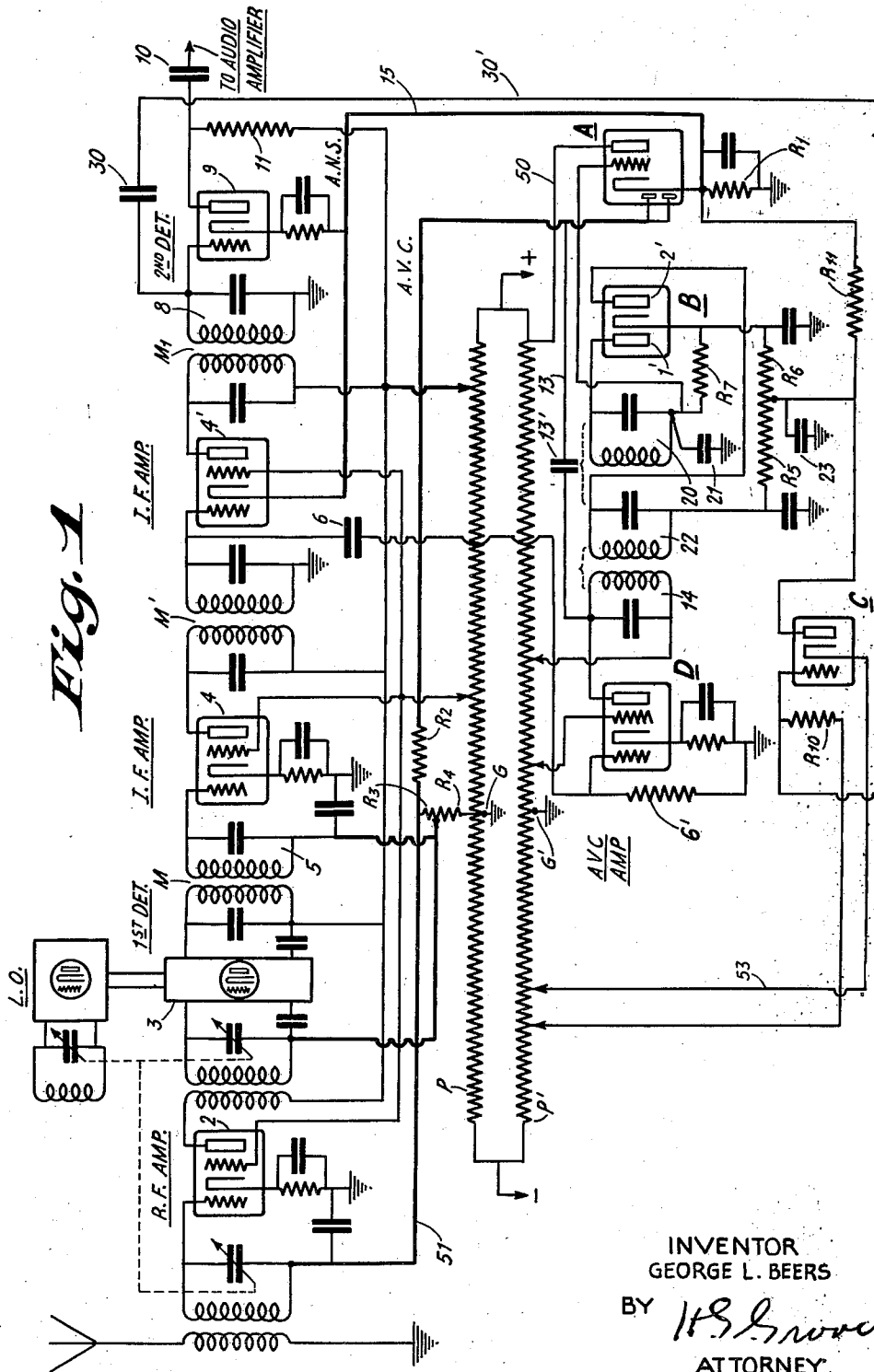
G. L. BEERS

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AUTOMATIC VOLUME CONTROL CIRCUIT

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INVENTOR
GEORGE L. BEERS
BY *H. S. Brown*
ATTORNEY

UNITED STATES PATENT OFFICE

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AUTOMATIC VOLUME CONTROL CIRCUIT

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

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My present invention relates to gain control circuits for receivers, and particularly to radio receivers of the automatic volume control type utilizing background noise suppressor arrangements.

One of the main objects of this invention may be said to reside in a method for improving the selectivity of the background noise suppressor arrangement of a radio receiver, and to additionally provide the suppressor with an "on or off" characteristic with conventional tubes.

Another important object of the invention is to provide in a receiver equipped with an automatic volume control network and an inter-station noise suppressor tube, a plurality of tuned circuits and a double diode which are used to control the suppressor tube, and the difference in the selectivity between two tuned circuits being the main factor in determining the frequency band over which the noise suppressor arrangement will operate.

Another object of the invention is to provide a novel device for imparting an "on or off" characteristic to a background noise suppressor for a radio receiver equipped with an automatic volume control network, the characteristic being obtained through a feed back arrangement which utilizes an auxiliary tube so connected that as soon as a little signal potential is applied to the detector the tube increases the negative bias on the noise suppressor tube and permits more signal to get through.

Another object is to provide an automatic control system for a superheterodyne receiver which performs the functions of automatic volume control, inter-station noise suppression and regulation of the speed of effectiveness of the noise suppressor, the latter function being accomplished by the second detector tube, or by an auxiliary tube independent of the second detector.

Still other objects of the invention are to improve generally the efficiency of automatic volume control systems for radio receivers, and particularly to provide an improved volume control system which is not only reliable in operation, but is readily manufactured and assembled in a radio receiver.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims. The invention itself, both as to its organization and method of operation, will best be understood by reference to the following description taken in connection with the drawings, in which I have indicated diagrammatically several circuit organizations

whereby my invention may be carried into effect.

In the drawings:—

Fig. 1 diagrammatically shows a superheterodyne receiver embodying the invention,

Fig. 2 is a modified form of the device for imparting the "on or off" characteristic to the background noise suppressor,

Fig. 3 is a further modification of the invention.

Fig. 4 is a graphical representation of the characteristic of transformer 64 in Fig. 3.

Referring now to the accompanying drawings, wherein like reference characters in the different figures designate similar circuit elements, it is first pointed out that Fig. 1 shows a radio receiving system of the superheterodyne type, the system including a quiet automatic volume control arrangement. The latter type of receiver instrumentality is used because one of the difficulties encountered in the operation of a radio receiver provided with a conventional automatic volume control system is the high level of noise reproduced when tuning between stations. This is due to the fact that an effective automatic volume control tends to keep the signal voltage at the second detector constant irrespective of the received signal strength.

This characteristic of an automatic volume control also gives the effect that when tuning in a strong signal from a local transmitter the receiver appears to lack selectivity. The result of this effect from the practical standpoint is that in tuning in a local station with such a receiver, the inexperienced user is likely to leave the receiver tuned to the side of the desired carrier wave thereby causing distortion of the receiver program.

To overcome such inter-station noises, background noise suppressor arrangements of various types have been developed. Noise suppression systems which render some portion of the receiver inoperative until a signal of a desired strength has been tuned in have been incorporated in a number of modern broadcast receivers. In some of these additional selectivity has been used between the automatic volume control and noise suppression systems. Through the use of this latter arrangement the selectivity of the noise suppression system can be made such that no sound will be heard from the receiver until it is within one or two kilocycles off resonance with the desired signal. The chief disadvantage of such a system is that the additional selective circuit is independent of the circuits which feed the signal to the second detector,

and, if the alignment of this circuit with the other circuits of the receiver is destroyed, it then becomes impossible to tune the receiver properly.

It is the ultimate goal of the arrangements shown in the present disclosure to improve the selectivity characteristic of a noise suppression system, and, in addition, to provide a method of giving such a system an "on and off" characteristic while using conventional tubes. Considering, then, the circuit arrangement in Fig. 1 it will be observed that the receiver comprises a signal collector, such as a grounded antenna circuit, which is followed by a tunable radio frequency amplifier 2 of conventional design, a first detector 3 of any well known construction, and an intermediate frequency amplifier network 4, 4'.

The network 3 is fed with locally produced oscillations from the local oscillator "L. O." The oscillator and first detector may be coupled in any desired manner well known in the art. Of course, any other type of frequency changer may be used. For example, the local oscillator and first detector may be embodied in a single tube.

The tuning devices of the amplifier 2, local oscillator and frequency changer 3 are uni-controlled, and the dotted lines are to be understood as designating the uni-control tuning means for the tuning condensers of the signal and local oscillation circuits. The transformer M has its primary and secondary windings tuned to the operating intermediate frequency. The tuned secondary circuit 5 is connected to the input electrodes of the amplifier 4. The coupling transformer M' connects the tuned output circuit of tube 4 to the input electrodes of intermediate frequency amplifier 4'. The input circuit of tube 4' is coupled, through a signal path including condenser 6, to the input circuit of the volume control amplifier D. The latter functions to amplify the intermediate frequency energy fed from the input circuit of the intermediate frequency amplifier 4' to the automatic volume control and suppressor circuits. The resistor 6' in series with condenser 6 serves to supply bias voltage to the signal input grid of tube D.

The anode of tube 4' is connected to the tuned primary circuit of the coupling transformer M₁. The tuned secondary circuit 8 is connected between the input electrodes of the second detector tube 9, the tuned windings of the coupling M₁ being, of course, resonant to the operating intermediate frequency. The anode potential for tube 9 is derived from the voltage supply network of the receiver, the audio potential component of the demodulated signal current developed across load resistor 11 being transmitted through coupling condenser 10 to one or more stages of audio amplification, a loud speaker (not shown) following the final audio amplifier stage. The voltage supply network includes the two bleeder resistors P—P' connected in parallel.

The letters G and G' designate the ground points on the bleeder resistors, and one junction of the resistors is connected to the positive side of the supply line, while the other junction is connected to the negative side. The two resistors in actual practice may be one.

The automatic volume control network is of a type disclosed and claimed by W. L. Carlson, et al., in application Serial No. 648,422, filed December 22, 1932. Such a network comprises a control tube A of the 55 type, also known as a duplex diode triode. The latter comprises within a common tube envelope a triode section and

a pair of diode sections, all sections having a common cathode and the diode anodes being outside the electron stream to the grid and plate of the triode section. Such a tube is described and claimed by T. M. Shrader in application Serial No. 622,140, filed July 12, 1932, Patent No. 2,058,834 of October 27, 1936. The diode anodes of tube A are tied together, the anodes being connected through lead 13 and condenser 13' to the anode side of the tuned output circuit 14 of tube D.

The plate of tube A is connected by lead 50 to a positive potential point on the resistor P', the cathode lead returning to the negative side of the bleeder through ground. A resistor R₁ is inserted in the cathode lead of tube A to maintain the cathode at a predetermined positive potential above ground when signals below a desired intensity level are received. Between the diode anodes of tube A and the ground side of its cathode are connected three resistor sections R₂, R₃, R₄ in series. The grid of the amplifier 2 is connected to the junction of resistors R₂ and R₃ through lead 51, while the signal grids of the tubes 3 and 4 are connected to the junction of resistors R₃ and R₄. These connections are the automatic volume control connections to the radio amplifier first detector and intermediate frequency amplifier 4, and the symbol "AVC" is used to designate the connections.

Current will flow through the series resistive path R₂—R₃—R₄—R₁ only when the diode anodes of tube A are positive with respect to the cathode. As long as signals below a predetermined intensity level are impressed upon the second detector 9, the grid of tube A is at a minimum negative potential, and the space current flow through resistor R₁ is a maximum. In this condition two things happen. First, the cathode of tube A is positive with respect to the diode anodes thereby preventing flow of current through the diode circuit. This results in a delayed automatic volume control action since the controlled tubes are at maximum sensitivity in this condition. Secondly, and by virtue of the direct current connection 15 between the cathodes of amplifier 4' and second detector 9 and the cathode side of resistor R₁, the intermediate frequency amplifier and second detector are biased substantially to cut-off to prevent the transmission of undesired background noise impulses to the audio amplifier network. If the noise suppressor connection (designated ANS) were not used, the noises would be greatly amplified due to the controlled amplifiers operating at maximum sensitivity in the "no-signal" condition.

The control circuit for the grid of tube A includes a tube B, and the latter includes a cathode and a pair of diode anodes 1', 2'. The anode 1' is connected to the cathode through a path which includes in series the tuned circuit 20 and the resistor R₇ having a value of about 1 megohm, a radio frequency by-pass condenser 21, of about 0.001 mfd., being connected between the negative side of resistor R₇ and ground. The anode 2' is connected to the cathode of tube B through a path which includes in series the tuned circuit 22, the resistor R₅ and resistor R₆, the latter two resistors having values of 200,000 ohms and 250,000 ohms respectively. The junction of resistors R₅ and R₆ is connected to the anode of tube C whose function will shortly be described, a radio frequency by-pass condenser 23 of 0.001 mfd. being connected to ground from the said junction.

The tuned circuits 14, 22 and 20 are coupled in cascade, and are all tuned to the operating intermediate frequency. The grid of tube A is connected to the anode side of resistor R₇. In the arrangement shown in Fig. 1 the difference in the selectivity preceding two parts of the noise suppression system determines the frequency band over which the device will operate. This result is accomplished by causing the part of the system which has the least selectivity to oppose the part which has the greatest selectivity. Tube B is a double diode which controls the grid bias of tube A. Diode 1' is preceded by the greatest selectivity, and when a signal is applied causes the bias of tube A to become more negative.

Diode 2' is preceded by less selectivity than diode 1', and a signal impressed on this diode causes the grid bias of tube A to become more positive. If the selectivity and gain preceding each of the diodes was the same and the same resistance was used in each circuit, the grid bias of tube A would not change irrespective of the signal strength. However, the selectivity ahead of diode 1' is greater than that ahead of diode 2' and the amount of change in bias of tube A provided by each diode can be controlled through the use of the two resistors R₅ and R₆ included in the circuit with diode 2'. The frequency band over which the grid bias of tube A is caused to become negative is determined by the difference in the selectivity of the circuits ahead of the two diodes, and the relative signal voltage applied to each diode of tube B.

The operation of the control system up to the present point will now be described. When the receiver is detuned from the desired signal the bias on the grid of tube A is zero, and the intermediate frequency amplifier tube 4' and second detector 9 are biased so as to be inoperative by the voltage drop across the resistor R₁ in the cathode circuit of tube A. As the receiver is tuned towards resonance with the desired signal a comparatively large signal voltage is applied to diode 2' while the signal voltage on diode 1' is still negligible.

The signal applied to diode 2' causes the bias of tube A to become positive. As the receiver is tuned nearer to resonance with the signal, the signal applied to diode 2' reaches its maximum value, and the signal applied to diode 1' becomes of such a value that the negative bias derived from this diode offsets some of the positive bias derived from diode 2'.

When the receiver is tuned to within two or three kilocycles off resonance the bias derived from diode 1' becomes greater than that from diode 2' so that the effective bias on tube A becomes negative reducing its plate current to a low value, and causing the intermediate frequency amplifier 4' and the second detector 9 to operate in a normal manner. The practical effect of this system is to cause the frequency band width, over which sound will be heard as the receiver is tuned through a desired station, to be limited to the frequency band width of the receiver selectivity curve at approximately twice normal input. This frequency band over which a station can be received with this noise suppressor is practically independent of the strength of the received signal.

With a noise suppressor of the conventional type which does not use some means for improving its selectivity, the frequency band over which sound can be heard as the receiver is tuned through resonance with a desired signal is

a function of the strength of the signal. If the signal strength is 1,000 times the normal input of the receiver the frequency band width over which the noise suppressor will operate will be the frequency band width of the receiver selectivity characteristic at 1,000 times normal input which for some receivers is approximately 25 kilocycles. For a signal strength of twice normal input the frequency band width will be approximately 6 kilocycles.

The relative value of resistors R₅ and R₆ determine the magnitude of the positive bias potential applied to the grid of tube A. This potential must be so adjusted that when the receiver is tuned to resonance, the negative bias potential derived from diode 1' is greater than the positive bias potential. If the coupling between the tuned circuits 20 and 22 were changed, it would probably be necessary to change the relative value of resistors R₅ and R₆ in order to obtain satisfactory operation of the noise suppressor.

The tube C, and its functioning in the system described above, will now be considered. The grid of the tube is connected to the high alternating potential side of the tuned input circuit 8 of the second detector 9 through a lead 30' and condenser 30. The grid and cathode of tube C are maintained at different potentials by connecting the cathode lead of tube C through lead 53 to a point on resistor P', the grid of the tube being connected through resistor R₁₀ to a point on bleeder P' which is negative with respect to the cathode point. The plate of tube C is connected through resistor R₁₁, having a value of 500,000 ohms, to the cathode side of resistor R₁.

The function of the tube C is to impart an "on or off" characteristic to the noise suppression arrangement without the use of tubes of special construction. It will be noted that the 500,000 ohm resistor R₁₁ in the plate circuit of tube C is also included in the grid circuit of tube A. An increase in the current flowing through this resistor causes an increase in the negative grid bias of tube A. The grid of tube C is connected to the grid of the second detector through a coupling condenser. Therefore, the signals which are applied to the grid of the second detector are likewise applied to the grid of tube C. Tube C is biased so that its plate current when no signal is applied is negligible.

As a signal is tuned in the grid bias of tube A derived from diodes 1' and 2' finally becomes slightly negative. This reduces the plate current flowing through the resistor R₁ in the cathode circuit of tube A, and thus causes a corresponding reduction in the negative bias applied to the intermediate frequency amplifier tube, which feeds signals to the second detector, as well as a reduction in the bias applied to the second detector. This allows a signal of small amplitude to be applied to the second detector 9 and tube C. The signal applied to tube C causes an increase in its plate current which in turn causes an increase in the negative bias of tube A, thus permitting a signal of greater amplitude to reach tube C.

In other words, a feed back system is employed so that as soon as the slightest signal is permitted to reach the second detector the bias of the intermediate frequency amplifier tube 4' feeding the second detector returns to its normal value. With a system of this type having an "on or off" characteristic, the bias of the second detector can be controlled simultaneously with the intermediate frequency amplifier and thereby

provide a greater degree of control. Considerable distortion would result at certain signal levels if the systems of the past were used to control the bias of the second detector.

5 In cases where it is desired to combine the function of demodulation with that of tube C the modified circuit shown in Fig. 2 may be employed. Only those portions of the circuits associated with tubes 9 and C which have been modified are
10 shown in the interests of simplicity of description. The tube C' may be employed to demodulate the intermediate frequency signal and impart the "on or off" characteristic to the noise suppressor. The tube C' is a diode whose anode
15 is connected to its cathode through tuned circuit 8 arranged in series with load resistor 41, the latter being shunted by a radio frequency by-pass condenser 42.

The anode side, or negative terminal, of resistor 41 is connected by lead 40 to the junction of resistors R₅ and R₆. The audio coupling condenser 10 is connected to the negative side of resistor 41, the resistor R₁ in the cathode circuit of tube A being connected at its ungrounded end
20 to the cathode side of resistor 41.

The operation of this modification will be clear from the foregoing description of the arrangement in Fig. 1, as well as the following explanation. As soon as signals are impressed on tuned circuit 8 the current flowing through the circuit of diode C' develops a voltage across resistor 41. The direct current potential component is used to negatively bias the grid of tube A as described in Fig. 1. This results in a decreased voltage
30 drop across resistor R₁, and a corresponding reduction of the bias on tube 4'. In this way still more signals are permitted to be impressed on the second detector diode. As signals decrease in intensity the reverse action takes place.

In the foregoing description it was pointed out that noise suppressor systems of the type which required the use of additional selective circuits are subject to the limitation that if the selective circuit for any reason becomes detuned, the noise suppressor will then cause the user of the receiver to tune it to one side of the desired carrier wave. The arrangement shown in Fig. 1 does not avoid this difficulty, since tuned selective circuits which are not in the signal channel are used to apply the
40 signal to the noise suppressor. In Fig. 3 there is shown a modified form of the invention, wherein the selective circuits which control the operation of the noise suppressor are the same circuits which are used to supply the signal to the second detector 60. This arrangement, therefore, avoids the aforementioned limitation.

In the circuit arrangement shown in Fig. 3 the element of the receiver system which is controlled is the audio amplifier tube 61. The radio frequency feed back system shown in Fig. 1 is not utilized in this embodiment of the invention. The intermediate frequency amplifier 62 has its tuned input circuit coupled to the first detector of the system through the tuned coupling means
60 63, and the tuned coupling transformer 64 couples the second detector to the plate circuit of the amplifier 62. The second detector is shown as of the diode type, the audio component of the demodulated signal energy being impressed upon the
70 grid of audio tube 61 through an audio coupling condenser 65.

The anode side of load resistor 66 is connected to the coupling condenser 65, and the same side of resistor 66 is connected to the junction of resistors 67 and 68 through a resistor 69. The du-

plex diode triode tube A has its grid connected to the plate of diode tube B' through the resistors 67', 67 and 68, the cathode of the diode tube being connected to the grid side of resistor 68. The function of resistor 67 (which has a value of 2
5 megohms, is to limit the grid current which tube A will take when its bias becomes positive. The diode plates of tube A are strapped together, and connected, through condenser 70, to the high potential side of the plate circuit of tube 62; while
10 condenser 71 connects the plate of diode B' to the same point.

The cathode of tube A is connected to ground through the resistor 72, and the cathode side of the resistor is connected by a lead 73 to the cathode side of resistor 66, and by a lead 74 to the cathode of audio amplifier 61. The grid of tube 61 is connected to ground through resistor 75. The automatic volume control circuit is provided by connecting the strapped diode anodes of tube A
20 to the grounded side of resistor 72 through the three resistor sections 76, 77 and 78 arranged in series. The connections from these resistor sections to the controlled stages are the same as described in connection with Fig. 1. The plate
25 circuit of audio tube 61 is connected to the audio output system, while the bleeder resistor P₁ provides the necessary potentials for the electrodes of the various tubes.

The operation of the modification shown in Fig. 3 will now be explained. As a signal is tuned in the signal potential applied to diode B' is greater than that applied to the second detector, due to the difference in the selectivity of the circuits preceding these two diodes. The bias on the control grid of tube A then becomes slightly positive. As the receiver is tuned more nearly into resonance with the desired signal, the signal applied to the second detector increases to the point where the negative bias obtained from the drop
40 across resistor 66 equals the positive bias derived from resistor 68. When tuned to within two or three kilocycles off resonance the drop across resistor 66 exceeds that across resistor 68, and the control grid of tube A becomes negative with
45 respect to its cathode thereby reducing the plate current flowing through resistor 72. When this current is reduced to a reasonably low value the bias on tube 61 returns to the normal value and the complete receiver then functions in the usual
50 manner. The diode B' performs the same function as the diode 2' in Fig. 1.

The effect of the selectivity characteristics of the tuned circuits of transformer 64 may be best understood by reference to Fig. 4 which shows
55 the relative voltage obtained across the primary and secondary of this transformer as the frequency is varied. As is typical of coupled tuned circuit transformers, there is a pronounced dip in the voltage developed across the primary at the center of the frequency band passed by the transformer. The voltage developed across the secondary is a maximum at this point. This characteristic is made use of in the differential noise suppressor arrangement, since the voltage
65 which tends to give the noise suppressor tube a positive bias diminishes at the point of resonance, whereas the voltage which biases the control grid in a negative direction is a maximum at this point. This same characteristic may be utilized
70 in the arrangement shown in Fig. 1.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular
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organizations shown and described, but that many modifications may be made, without departing from the scope of my invention, as set forth in the appended claims.

What I claim is:

1. In a radio receiver having at least one amplifying stage, means for minimizing the gain in said stage during the absence of an incoming signal, means for deriving a plurality of uni-directional potentials in response to an incoming carrier wave, and means for differentially utilizing said potentials to render ineffective the action of the gain-minimizing means.

2. The invention set forth in claim 1, characterized in that the uni-directional potential deriving means is constituted by a plurality of devices, and further characterized in that means are provided whereby the selectivity ahead of one of said devices is more than the selectivity ahead of the other of said devices, whereby the said potentials appear sequentially as the tuning of the receiver approaches resonance with the carrier wave of a desired station.

3. The invention set forth in claim 1, characterized in that means are provided whereby one of said potentials tends to reinforce the action of the gain-minimizing means and whereby the other of said potentials tends to nullify the action of the gain-minimizing means, and further characterized in that selective means are provided whereby the potentials appear in the order given as the tuning of the receiver approaches resonance with the carrier wave of a desired station.

4. The invention set forth in claim 1, additionally characterized in that energy feed-back means are provided for regeneratively increasing the differential between the said uni-directional potentials whereby there is a sharp increase in the rate at which the minimizing means is rendered ineffective as a signal is tuned in.

5. In a radio receiver, a signal receiving and amplifying channel having a predetermined degree of selectivity, means for rendering inoperative an element in said channel during the absence of an incoming signal, means for utilizing an element in said channel for counteracting the action of the last mentioned means, and means extraneous to said channel but coupled thereto, for opposing the action of the first named means.

6. In combination, means for deriving a plurality of discrete uni-directional potentials from a radio signal, means for algebraically combining the effects of said potentials for control purposes, and regenerative means for reinforcing the effect of one of said potentials and opposing the effect of another.

7. In combination, means for deriving a plurality of discrete uni-directional potentials from a radio signal, means for algebraically combining the effects of said potentials for control purposes, and additional means for regeneratively utilizing the signal to reinforce the effect of one of said potentials and opposing the effect of another.

8. In a tunable radio receiver, at least two amplifying stages, means for biasing one of said stages to substantially the cut-off potential during the absence of an incoming signal, uni-directional potential providing means responsive during the tuning of the receiver toward resonance with the carrier wave of a desired signal and relatively less responsive at the resonance point, uni-directional potential supplying means having maximum response at the resonance point, means for utilizing the potential from the first-mentioned potential supplying means to re-

inforce the action of the biasing means, and means for utilizing the potential from the second-mentioned potential supplying means for opposing the effect of the potential from the first mentioned potential supplying means.

9. The invention set forth in claim 8, further characterized in that regenerative means are provided for regeneratively reinforcing the action of the potential supplying means having maximum response at resonance, whereby the biasing potential is abruptly removed from the biased stages as the receiver is tuned to resonance with a desired signal.

10. In a radio receiving system, means for suppressing inter-station noises, a signal responsive device for controlling the action of said noise suppressing means, a second signal responsive device for controlling said noise suppressing means, and connections whereby the action of the two signal responsive devices is in the opposite sense.

11. In combination, means for deriving a plurality of discrete uni-directional potentials from a radio signal, means for utilizing the algebraic sum of said potentials for controlling the conductivity of an impedance device, and additional means for regeneratively utilizing the signal to reinforce the effect of one of said potentials and oppose the effect of another.

12. In a multi-stage tunable radio receiving system, means for reducing the gain in at least one of said stages in the absence of an incoming signal, means including a circuit having a predetermined degree of damping for reinforcing the action of the first named means and means including a circuit having relatively less damping for nullifying the action of the second named means when signals from a desired station are tuned in.

13. In a tunable radio receiver, an amplifying stage, means for biasing said stage to substantially the cut-off potential during the absence of a signal, means functioning at maximum efficiency at each side of resonance with an incoming signal to provide a uni-directional potential, means functioning at maximum efficiency at resonance with an incoming signal to provide a second uni-directional potential and means for utilizing said potentials, respectively, for reinforcing the action of the biasing means and for nullifying the action of the biasing means.

14. In a radio receiver, at least two cascaded signal transmission tubes, an electron discharge tube of the type comprising a diode section and a section including at least a cathode, grid and anode, a signal path connecting one of the transmission tubes to said diode section, a circuit operatively associated with the diode section for developing a gain control voltage from received signals, means for applying the control voltage to a gain control point in the receiver, means responsive to variations in the space current flow of said discharge tube cathode circuit, for adjusting the signal transmission efficiency of the other cascaded tube, at least two rectifier networks, means for impressing signals on the networks to derive uni-directional potentials therefrom, and means for differentially applying the potentials to said grid thereby to control said transmission efficiency adjustment.

15. In a multi-stage radio receiver, an inter-tube transformer having a tuned primary winding and a tuned secondary winding, means for blocking at least one of said stages during the absence of an incoming signal, means for utiliz-

ing potentials developed across the secondary of the transformer for rendering inactive the blocking means and means energized from the primary of the transformer for counteracting the action of the means for utilizing the potentials developed across the secondary thereof, whereby the apparent selectivity of the receiver with respect to the blocking function is increased over the selectivity of the transformer per se.

16. In a radio receiver, a main signal amplifying channel including a plurality of tuned stages and having a predetermined degree of selectivity, means for blocking at least one of said stages during absence of a signal in said channel, means whereby another of said stages provides a uni-directional potential in response to an incoming signal, means extraneous to said channel for providing a second uni-directional potential in response to an incoming signal in said channel and means for utilizing the algebraic sum of said potentials for rendering ineffective the action of the stage blocking means, the extraneous potential providing means having a response characteristic exhibiting a pronounced dip at a frequency whereat the response of the potential-supplying stage is maximum, whereby the apparent selectivity of the receiver with respect to the function of stage-blocking is greatly increased over the selectivity of the signal amplifying channel per se.

17. In combination with a high frequency amplifier whose gain is to be controlled, a gain control tube comprising a diode section and a triode section having a common cathode, an impedance connected in circuit with said diode section, a direct current connection between a point on said impedance and the grid circuit of said amplifier, a second impedance in the cathode circuit of said gain control tube, a second amplifier following the first amplifier, a direct current connection between the cathode side of said second impedance and the cathode circuit of said second amplifier, a second control tube including a cathode and at least two anodes, a pair of tuned circuits resonant to the operating signal frequency connected between each of said last named anodes and the cathode of said second control tube, one of said tuned circuits being coupled between the output circuit of said amplifier and the other tuned circuit, and a direct current connection between the grid of said triode section and a point in the diode circuit including said other tuned circuit.

18. In combination with a high frequency amplifier whose gain is to be controlled, a gain control tube comprising a diode section and a triode section having a common cathode, an impedance connected in circuit with said diode section, a direct current connection between a point on said impedance and the grid circuit of said amplifier, a second impedance in the cathode circuit of said gain control tube, a second amplifier following the first amplifier, a direct current connection between the cathode side of said second impedance and the cathode circuit of said second amplifier, a second control tube including a cathode and at least two anodes, a pair of tuned circuits resonant to the operating signal frequency connected between each of said last named anodes and the cathode of said second control tube, one of said tuned circuits being coupled between the output circuit of said amplifier and the other tuned circuit, and a direct current connection between the grid of said triode section and a point in the diode circuit including

said other tuned circuit, a demodulator, means for impressing the signal output of said amplifier upon said demodulator, a rectifier having its input electrode coupled to the input of said demodulator, and a direct current connection between the output electrode of said last named rectifier and the grid of said triode section.

19. In combination with a high frequency amplifier whose gain is to be controlled, a gain control tube comprising a diode section and a triode section having a common cathode, an impedance connected in circuit with said diode section, a direct current connection between a point on said impedance and the grid circuit of said amplifier, a second impedance in the cathode circuit of said gain control tube, a second amplifier following the first amplifier, a direct current connection between the cathode side of said second impedance and the cathode circuit of said second amplifier, a second control tube including a cathode and at least two anodes, a pair of tuned circuits resonant to the operating signal frequency connected between each of said last named anodes and the cathode of said second control tube, one of said tuned circuits being coupled between the output circuit of said amplifier and the other tuned circuit, and a direct current connection between the grid of said triode section and a point in the diode circuit including said other tuned circuit, and a diode having a tuned circuit resonant to said signal frequency connected between the anode and cathode thereof, said last tuned circuit being coupled to the output of said amplifier, a third impedance in the circuit of said last named diode, means for connecting a point of negative direct current potential on said third impedance to the grid of said triode section.

20. In combination with a high frequency amplifier whose gain is to be controlled, a gain control tube comprising a diode section and a triode section having a common cathode, an impedance connected in circuit with said diode section, a direct current connection between a point on said impedance and the grid circuit of said amplifier, a second impedance in the cathode circuit of said gain control tube, a second amplifier following the first amplifier, a direct current connection between the cathode side of said second impedance and the cathode circuit of said second amplifier, a second control tube including a cathode and at least two anodes, a pair of tuned circuits resonant to the operating signal frequency connected between each of said last named anodes and the cathode of said second control tube, one of said tuned circuits being coupled between the output circuit of said amplifier and the other tuned circuit, and a direct current connection between the grid of said triode section and a point in the diode circuit including said other tuned circuit, and a diode having a tuned circuit resonant to said signal frequency connected between the anode and cathode thereof, said last tuned circuit being coupled to the output of said amplifier, a third impedance in the circuit of said last named diode, means for connecting a point of negative direct current potential on said third impedance to the grid of said triode section, and additional means for impressing the audio component of a rectified signal voltage developed across said third impedance upon an audio frequency amplifier.

21. In combination with a high frequency amplifier whose gain is to be controlled, a gain control tube comprising a diode section and a triode

section having a common cathode, an impedance connected in circuit with said diode section, a direct current connection between a point on said impedance and the grid circuit of said amplifier, a second impedance in the cathode circuit of said gain control tube, a second amplifier following the first amplifier, a direct current connection between the cathode side of said second impedance and the cathode circuit of said second amplifier, a second control tube including a cathode and at least two anodes, a pair of tuned circuits resonant to the operating signal frequency connected between each of said last named anodes and the cathode of said second control tube, one of said tuned circuits being coupled between the output circuit of said amplifier and the other tuned circuit, and a direct current connection between the grid of said triode section and a point in the diode circuit including said other tuned circuit, a resistor in circuit with said diode section including said other tuned circuit, a second

resistor in circuit with the remaining diode section, a rectifier having its input electrode connected through a signal path to the output of said amplifier, and a direct current connection including said two resistors to the grid of said triode section. 5

22. In a high frequency signalling system, means for adjusting the signal transmission efficiency of said system, means for controlling the signal transmission through the system in an opposite sense to said adjustment, means including circuits of different selectivity for providing at least two uni-directional potentials whose magnitude and polarity are dependent upon a desired signal, means for utilizing said potentials to control the effectiveness of operation of said control means, and additional means, responsive to said desired signal, for increasing the rate of effectiveness of said control means. 10 15

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