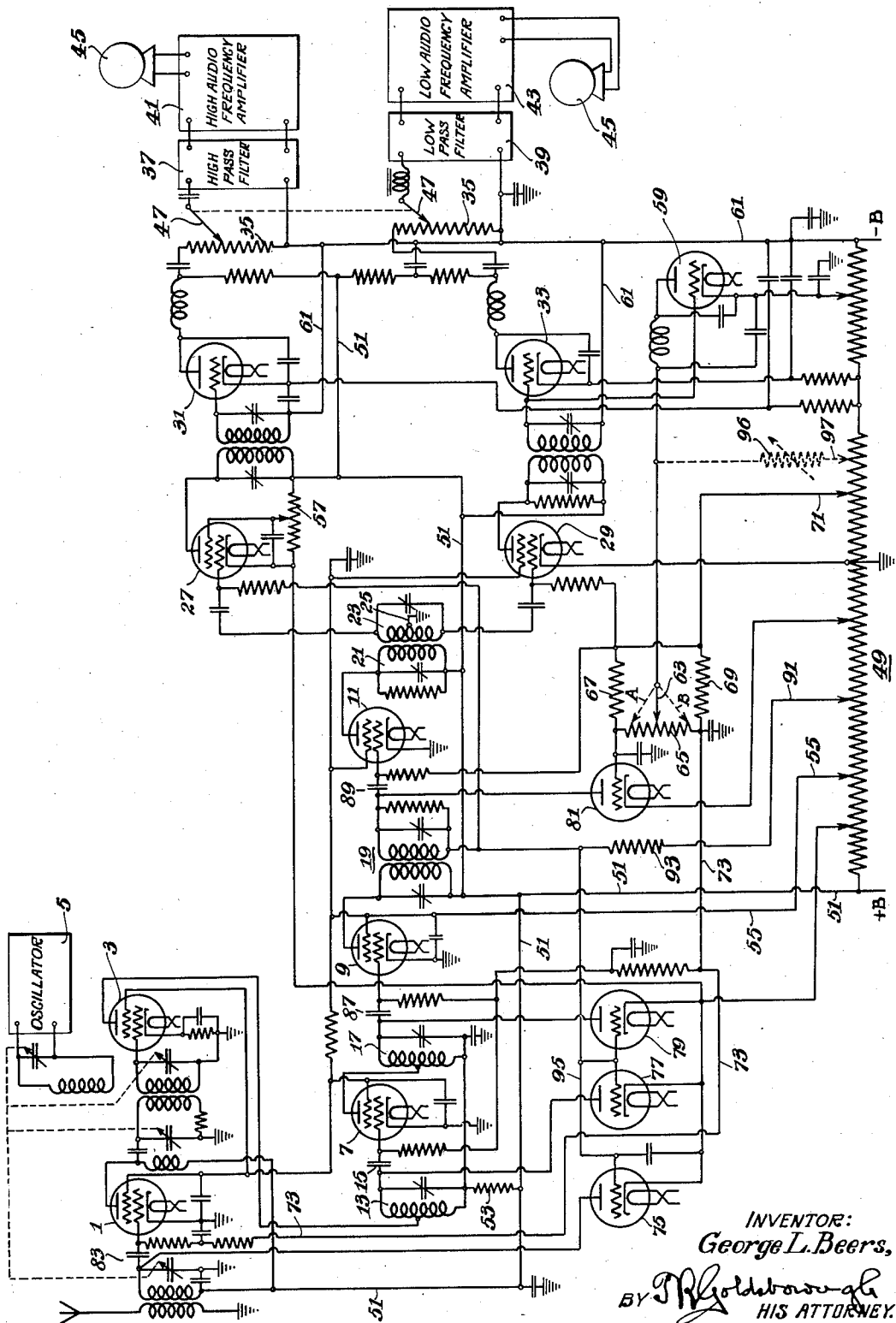


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AMPLIFIER

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My invention relates to amplifiers and, more particularly, to amplifiers of the type suitable for use in the reception of radio signals.

When a radio receiver is provided with automatic selectivity control devices for the purpose of attaining high fidelity in the reception of strong signals from local stations and the elimination of objectionable background noise and other interference during the reception of weak signals from distant stations, a condition may be encountered where interference will result during the reception of signals from a distant station having a carrier frequency adjacent to that of a strong local station. This interference becomes objectionable when the distant station has sufficient signal strength to automatically broaden out the receiver selectivity characteristic to such an extent that it includes the side bands of the undesired local station. In such event, the interference manifests itself as noise having somewhat the characteristic sound of steam escaping in intermittent jets from an orifice, the pitch and periodicity of the noise varying from time to time. Obviously, the shift in periodicity and pitch of the interfering noises is a function of the frequency of the desired carrier and the frequencies of the interfering side bands.

It is, therefore, an object of my invention to provide a receiver, of the type wherein selectivity is automatically controlled, that shall be free of the interference phenomenon referred to above.

Another object of my invention is to provide, in a radio receiver, means for automatically increasing the selectivity during the reception of weak signals.

Another object of my invention is to provide a high fidelity radio receiver having automatic volume and selectivity control.

Another object of my invention is to provide, in a receiver of the type referred to, means for automatically and simultaneously controlling the fidelity characteristics of the radio and audio frequency amplifying portions thereof.

Another object of my invention is to provide a radio receiving system equipped with automatic volume control in which the automatic volume control action may be obtained either through variations in the damping of the circuits, or by variation of the characteristics of the amplifier tubes.

Another object of my invention is to provide a receiver wherein smoothly continuous selectivity control may manually be accomplished during the reception of signals from strong local stations.

Yet another object of my invention is to provide

a radio receiving system in which the selectivity is always maximum when the sensitivity is maximum and in which the selectivity in the minimum sensitivity condition can be controlled manually.

A still further and more specific object of my invention is to provide a manually operable selectivity control for high fidelity radio receivers of the type referred to, whereby the user thereof may alter its characteristics to suit local reception conditions.

All the tests which I have made indicate that a receiver of the high fidelity type should be equipped with both automatic selectivity control and automatic fidelity control. The automatic selectivity control, as herein referred to, controls the fidelity of the receiver as well but, under certain conditions, the aforementioned objectionable beat-note interference is still encountered on account of the high frequency response of audio frequency amplification systems of preferred types. Such interference would be eliminated if the fidelity characteristic of the audio frequency portion of the receiver could be caused to vary simultaneously with the change in selectivity and fidelity of the radio frequency portion.

According to one modification of my invention, I accomplish the automatic control of the audio frequency fidelity, in part, by supplying to the grids of certain of the thermionic tubes in a radio receiver grid biasing potentials controlled as to their amplitude by incoming signals. I also utilize the incoming signals to automatically control the damping in certain of the inter-tube coupling circuits preceding the audio frequency amplifying stages and, concurrently therewith, the transfer of energy between the tubes. Furthermore, in one modification of my invention, I discard the usual single second detector of a superheterodyne receiving system and utilize, instead, a plurality of second detectors each of which, respectively, is followed by an audio frequency amplifier. One of the audio frequency amplifiers is so designed as to efficiently handle currents at frequencies of 30 to 1500 cycles per second, and the other, currents at frequencies from 1500 to 10,000 cycles.

Preferably, two separate intermediate amplifying tubes are used to feed the individual detectors and means are provided whereby the gain in one tube may be varied with respect to the gain in the other. That is to say, automatically functioning means are so provided that, when the receiver is tuned to a weak distant station, the selectivity is at a maximum, and the gain in the intermediate frequency tube feeding the detector, to which the

high audio frequency amplifier is connected, is reduced, which reduction prevents high frequency beat-notes and other interference.

The manual selectivity control, mentioned above, preferably takes the form of a potentiometer connected in the plate circuit of the volume control tube and means are provided whereby, through adjustment of a slider associated with the potentiometer, the automatic volume-control action may be apportioned between certain selectivity control tubes and the thermionic amplifier tubes per se.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawing, the single figure of which is a diagrammatic view of a portion of a radio receiver constructed according to my invention.

Although my invention is susceptible of application to radio receivers of many different types, it may be illustrated, referring to the drawing, as applied to a superheterodyne receiver including a radio frequency amplifier tube 1, a first detector tube 3, an oscillator 5, and a plurality of intermediate frequency amplifier tubes 7, 9, and 11. Each of the tubes so far enumerated is, preferably, of the screen grid, equi-potential cathode type, though tubes of other types may, of course, be used. The several heaters, as is well known to those skilled in the art, may be supplied with alternating current from any convenient low potential source (not shown).

The first detector tube 3 is coupled to the first intermediate frequency amplifier tube 7 through a tuned circuit 13 which is directly connected to the anode of the first detector tube and which, through a coupling condenser 15 is connected to the control grid of the first intermediate frequency amplifier tube. The first and second intermediate frequency amplifier tubes 7 and 9 are inter-connected through a similar tuned circuit 17. The second and third intermediate frequency amplifier tubes 9 and 11 are coupled through a transformer 19, the primary and secondary windings of which are so tuned and the coupling between them so adjusted that the transformer efficiently passes a band of frequencies 10 kilocycles above and below the chosen intermediate frequency.

The third intermediate frequency amplifier tube 11 is provided with a tuned output circuit 21 which is coupled in the manner just described to a tuned circuit 23 having an intermediate ground connection 25. The terminals of the said tuned circuit 23 are, respectively, connected to the input electrodes of a plurality of individual intermediate frequency amplifier tubes 27 and 29, the output circuits of which are coupled, respectively, to the input circuits of a plurality of second detector tubes 31 and 33.

The transformers connecting the fourth intermediate frequency amplifier tubes 27 and 29 to the corresponding detector tubes 31 and 33 are also of the tuned and band-pass type referred to above.

Each of the second detector tubes 31 and 33 is provided with an output resistor 35, the low potential ends of the resistors being connected together and to ground through a by-pass condenser. Audio potentials developed across the several resistors are impressed, through high and

low pass filters 37 and 39, upon individual high and low audio frequency amplifiers 41 and 43, each amplifier being provided with an individual loudspeaker 45.

For manual volume control purposes, each output resistor 35 is connected to its associated filter through an adjustable slider 47 and, preferably, the two sliders are mechanically inter-connected for simultaneous operation.

A source of anode and grid biasing potentials (not shown) is supplied, across the output circuit of which is connected a resistor 49. Plate potential for all of the tubes thus far described is provided by a common connection 51 extending to the positive end of the resistor 49, a resistor 53 being provided between the said connection and the anodes of the first detector tube and the first intermediate frequency amplifier tube to reduce somewhat the voltage applied thereto.

The screen grids of the several tubes in the system may be supplied with positive potential over a common conductor 55 either from a point on the resistor 49 slightly less positive than the point supplying anode potential thereto, or may be connected, as is the fourth intermediate frequency amplifier tube 27, to the anode thereof over a bleeder resistor 57 from which the requisite positive potential is derived. Inasmuch as the manner in which the anodes and screen grids of the tubes in the system may, in general, be provided with potential from the resistor 49 is familiar to those skilled in the art, it is not necessary to describe, in detail, the connections to each tube.

That portion of my improved radio receiver thus far described, except for the dual audio portion thereof, is quite similar to superheterodyne receivers of the usual type. Obviously, such a receiver would respond to every change in the amplitude of an incoming signal, since it is devoid of means for automatically altering either its selectivity or its sensitivity in response to signal amplitude changes.

In order that automatic sensitivity control may be had, it is necessary to provide some means whereby an increase in signal amplitude or, more properly, in the amplitude of the desired carrier frequency, may be met and compensated by a change in gain.

To attain automatic fidelity control means must also be provided whereby the receiver shall be selective when operated to receive weak signals from distant stations and more broadly tuned when used for the reception of strong signals from nearby stations.

To this end, I provide carrier-amplitude responsive control devices that function to automatically correlate the selectivity and sensitivity of the receiver to the strength of the incoming signal to which it is tuned.

In addition, I provide manually operable means for shifting the automatic action from combined selectivity and sensitivity control to simple gain control and, concurrently therewith, for removing automatic control from the audio frequency amplifier and rendering a portion of it inactive to amplify signals.

To the above-mentioned ends, I provide a volume control tube 59 of the equi-potential type having an anode, a control grid, an electronically active cathode, and a heater. The grid of the automatic volume control tube is directly connected to the grid of the second detector tube 33 which supplies the low audio frequency am-

plifier 43 and, as will be noted from an inspection of the drawing, the grid of the said detector tube is connected by way of a conductor 61 to the negative end of the main potential supply resistor.

The anode circuit of the volume control tube includes the slider 63 of a potentiometer, the terminals of the resistance element 65 thereof being connected together over resistors 67 and 69 and the junction between these resistors being connected to a point 71 on the main potential supply resistor more positive than the point thereon to which the cathode of the automatic volume control tube 59 is connected. The potentiometer resistance element 65, preferably, has a resistance of 700,000 ohms, while the resistors 67 and 69 connected, respectively, to the ends thereof have each a resistance of 100,000 ohms.

It will also be noted from an inspection of the drawing that the control grids of the radio frequency amplifier tube 1 and the first and second intermediate frequency amplifier tubes 7 and 9 are directly connected to the lower end of the potentiometer resistor element by a conductor 73.

The automatic volume control tube is normally biased to substantially the cut-off point. An incoming signal, therefore, when applied to the grid thereof from the input circuit of the second detector tube causes an increase in the anode or output current, which current traverses the resistors 67 and 69 connected to the ends of the potentiometer element, and a variable portion of the said element, depending upon the adjustment of the slider 63.

If the slider is in the lower dotted position B, substantially all of the voltage caused by the plate current in the automatic volume control tube is developed across the lower resistor 69, with the result that an increased signal impressed upon the radio frequency amplifier tube and the first and second intermediate frequency amplifier tubes is met by a more negative grid potential applied thereto which reduces the gain therein, thus accomplishing automatic sensitivity control alone.

For the purpose of attaining combined automatic sensitivity and selectivity control, as distinguished from the type of control that may be had through the alteration of grid-biasing potentials alone, I prefer to provide additional, optionally usable means, responsive to changes in the plate current in the automatic volume control tube, which means function to control the characteristics of certain of the inter-tube coupling networks in the receiver.

Since, as before pointed out, one of the objects of my invention is achieved by controlling, automatically, the frequency response characteristic of the audio frequency amplifier concurrently with automatic control of the sensitivity and selectivity of the high frequency amplifying portion of the receiver, I also provide means whereby, when the optionally usable means are permitted to function, automatic control is applied to the audio frequency amplifier, as well, to lessen its high frequency response.

To accomplish combined automatic sensitivity and selectivity control, I provide a plurality of thermionic devices 75, 77, 79, and 81, the function of which is to control the damping in certain of the inter-tube coupling devices and the energy transfer therebetween, automatically in response to plate current in the tube 59, at the option of the user. These devices are hereinafter generally referred to as selectivity control tubes, although

they have other functions, as will be made clear.

The selectivity control tubes may be of the equipotential type, each having an anode, a control grid, a cathode, and a heater. The anode circuit of the first selectivity control tube 75 is connected in shunt to the input circuit of the radio frequency amplifier tube 1. The anode circuit of the second selectivity control tube 77 is connected in shunt to the input circuit of the first intermediate frequency amplifier tube 7, the anode circuit of the third selectivity control tube 79 is connected in shunt relation to the input circuit of the second intermediate frequency amplifier tube 9, while the anode circuit of the fourth selectivity control tube 81 effectively shunts the input circuit of the third intermediate frequency amplifier tube 11.

It will be noted from an inspection of the drawing that the input circuits of the several tubes just enumerated are, respectively, isolated from the grids of the said tubes by individual blocking condensers 83, 15, 87, and 89. It will also be noted that the input circuit of the radio frequency amplifier tube 1, as well as those of the first and second intermediate frequency amplifier tubes, are connected to the conductor 51 which supplies these tubes with anode potential. Such being the case, the first three selectivity control tubes are also supplied with anode potential from the conductor 51, as will be clear from an inspection of the drawing. Plate potential for the fourth selectivity control tube 81 is supplied from a point on the main potential supply resistor over a connection 91 including a resistor 93 and the secondary of the transformer 19 coupling the second and third intermediate frequency amplifier tubes.

Since the space current paths of the first three selectivity control tubes, respectively, are connected in shunt relation to the input circuits of the radio frequency amplifier tubes and the first and second intermediate frequency amplifier tubes, the impedances of these paths control the damping in the said circuits and also control the energy transfer from the antenna to the radio frequency amplifier tube, between the first detector and the first intermediate frequency amplifier tube, as well as between the first and second intermediate frequency amplifier tubes.

When it is desired to shift automatic control from simple gain control to combined sensitivity and selectivity control and, conjointly therewith, to apply control to the audio frequency amplifier, the slider 63 is moved from the position designated B in the drawing toward the position A, whereby the drop in potential across the resistor 69, by reason of space current in the automatic volume control tube 59, decreases and the drop across resistor 67 increases.

The grids of the first three selectivity control tubes are connected to a common conductor 95 and to the plate potential supply circuit of the fourth selectivity control tube 81 at a point intermediate between the resistor 93 and the transformer secondary 19 referred to above.

Also, the bias on the grid of the fourth selectivity control tube 81 is such that, normally, in the absence of incoming signals, a substantial plate current flows therein, which current causes sufficient drop across the resistor 93, connected to the grids of the first three selectivity control tubes, that they are biased to substantially the cut-off point. In such event, keeping in mind that the slider is toward the position A, the selec-

tivity of the system is high and weak signals are met by maximum amplification.

It will be noted that the grid of the amplifier tube 27 connected to the high audio frequency amplifier system 37-41 is connected to the same resistor 93 which supplies bias to the first three selectivity control tubes. In the sensitive condition, therefore, when tuned to receive weak signals, the said amplifier tube is biased highly negatively and the output therefrom is low, thus causing the burden of second detection and audio frequency amplification to be handled by the second detector 33 feeding the low audio frequency amplifier 39-43. With the high audio frequency system thus under control, beat-notes and background noise are substantially eliminated and the reception of signals from weak distant stations may be satisfactorily accomplished.

At the same time, the selectivity of the system is high, as pointed out, insofar as the radio frequency amplifier stage and the first and second intermediate frequency amplifier stages are concerned, which is the desirable condition for weak signal reception to assist in the elimination of background noise and beat-note interference.

However, as soon as the system is tuned to a strong signal, the plate current in the automatic volume control tube 59 increases and, if the slider is still adjusted toward the position A, a greater potential is developed across the resistor 67, which renders the grid of the fourth selectivity control tube 81 more negative, to reduce the plate current therein and, consequently, to decrease the potential drop across the resistor 93 included in the output circuit thereof.

Since the grids of the first three selectivity control tubes and the grid of the fourth intermediate frequency amplifying tube 27, allocated to high frequencies, are connected to the resistor 93, the impedances of the control tubes are reduced and the shunting effect of those tubes is increased, resulting in a broadening of the tuning of that portion of the receiver ahead of the third intermediate frequency amplifier and a decrease in the sensitivity thereof. The diminution of the shunting effect of the fourth selectivity control tube upon the input circuit of the third intermediate frequency amplifier tube increases the effective coupling between the second and third intermediate frequency tubes, thus increasing the fidelity of reproduction of the system during the reception of strong signals, though slightly offsetting the decreased sensitivity. Furthermore, since the resistor 93 is included in the circuit normally supplying cut-off bias to the amplifier tube 27 that feeds the detector 31 and the high audio frequency amplifier 41, the decreased current there-through makes such bias less negative, thus permitting the reproduced audio frequencies to cover a much greater range with consequent improved fidelity.

If, during the aforementioned condition, however, it is found that interference exists between the desired signal and a signal on an adjacent channel, the potentiometer slider 63 may be adjusted toward position B. Such adjustment, since it deprives all of the selectivity control tubes of grid potentials proportional to incoming signal amplitude, causes the said tubes to relinquish, more or less, control of selectivity. At the same time, the bias on the tube 27 becomes more negative, thus reducing the reproduction of high audio frequencies with consequent diminution or elimination of the interference noises.

If interference is excessive, the slider may be

moved to the extreme B position, thus rendering the selectivity maximum and completely stopping the high audio frequency response of the receiver.

To recapitulate, briefly, the mode of operation of my improved radio receiver, it should be clearly apparent that the potentiometer 63-65 has an extremely important function. Through the use of the said potentiometer, the characteristics of the receiver may be altered in a smooth and continuous manner.

When it is desired that the system shall be free of the objectionable interference phenomena hereinbefore referred to, the slider 63 is manually adjusted toward the position B and automatic volume control or gain control of conventional type is had on the radio frequency and intermediate frequency amplifier tubes and the high frequency portion of the audio frequency amplifier is rendered inoperative. On the other hand, when the reception of strong signals from nearby stations is desired, together with better fidelity of reproduction, provided no interference exists, the slider 63 is adjusted toward the position A, in which event automatic volume control is had through alteration of the characteristics of the intertube coupling devices and the high frequency portion of the audio frequency amplifier is permitted to function.

Any desired apportioning of automatic control between the two extremes just enumerated may be had by adjusting the slider 63 to intermediate positions upon the resistance element 65 of the potentiometer, as is, of course, obvious to one skilled in the art. The position A, however, is the normal position of the slider, movement thereof toward position B only being required in unusual situations.

It should be apparent that my invention is not limited to the specific circuit chosen for purposes of illustration. For example, instead of providing a separate audio frequency channel solely for the reproduction of high audio frequencies, I may make use of a single channel amplifier, as is customary. In such event, I provide a controllable high frequency path in shunt to the input circuit or the output circuit of the audio frequency amplifier, and control the impedance of the shunt from the automatic volume control tube which also controls the so-called selectivity control tubes. The specific manner in which the shunt may be controlled is not a feature of my present invention, but the system disclosed in my copending application, Serial No. 545,704, filed June 20, 1931, and assigned to Radio Corporation of America, is one that has given entire satisfaction.

In the said application is disclosed a thermionic tube, the space current path of which is effectively connected in series with a high frequency shunt across the input circuit of the audio frequency amplifier and the grid bias applied to the tube is made a function of an incoming signal. If this arrangement is utilized, the grid of the shunting tube is connected to the junction between resistors 65 and 67, shown in the drawing. That is to say, the connections are such that, as the selectivity of the radio frequency portion is automatically increased during the reception of weak signals, the high frequency response of the audio frequency amplifier is reduced. I wish, also, to have it understood that, in the form of my invention cited, as an example, the effect of each portion on the overall fidelity is maintained substantially equivalent, irrespective of the amount of control exerted thereon.

Many other modifications of my invention will at once be apparent to those skilled in the art to which it pertains. As a still further example, if the automatic control feature is not desired, the automatic volume control tube 59 may be omitted from the system illustrated in the drawing and a variable resistor 96, shown in dotted lines, of, say 100,000 ohms, be connected, instead, between the slider 63 and a point 97 on the resistor 49. If this is done, the slider 63 may be utilized to determine the effect, simultaneously, of the radio and audio portions on the overall fidelity while the resistor 96 may be adjusted to control the sensitivity of the receiver. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In a radio receiver, sensitivity and selectivity control means, audio frequency fidelity-control means, and means for simultaneously actuating each of said control-means.

2. In a radio receiver, sensitivity and selectivity control means, audio frequency fidelity-control means, and means for automatically actuating each of said control-means.

3. In a radio receiver, sensitivity and selectivity control means, audio frequency fidelity-control means, and means responsive to changes in strength of incoming signals for automatically actuating each of said control means.

4. In a radio receiving system, a radio frequency amplifying portion, an audio frequency amplifying portion, means for controlling the effect of each portion on the overall fidelity and for simultaneously controlling the fidelity of the said portions.

5. In a radio receiving system, the combination of a radio frequency amplifying portion, an audio frequency amplifying portion, and means for concurrently controlling the effect of each portion on the overall fidelity, said means being responsive to incoming signals.

6. In a radio receiving system, a radio frequency amplifying portion, an audio frequency amplifying portion, means for maintaining the effect of each portion on the overall fidelity substantially similar and for automatically controlling the fidelity of the said portions, and manually operable means for determining the degree of automatic control applied to the said portions, whereby the fidelity of reproduction may be adjusted during the reception of signals from strong local stations.

7. In a radio receiver, combined sensitivity and selectivity-control means, audio-frequency fidelity control means, means responsive to changes in strength of incoming signals for automatically actuating each of said control-means, and means for at will altering the measure of automatic control over the receiver characteristics enumerated, namely, over its sensitivity, selectivity, and audio frequency fidelity.

8. In a radio receiver, a plurality of electric discharge amplifier devices, coupling networks between certain of said devices, automatic volume control means for providing control-potentials for said amplifier devices means including electric discharge devices controllable by said automatic volume control means having space current paths in shunt with certain of the coupling networks and manually operable means for gradually applying said controlled potentials to said last named means.

9. In a receiver of the type equipped with auto-

matic selectivity, sensitivity, and audio frequency fidelity-control, manually operable means for adjusting the measure of fidelity-control and means for concurrently altering the selectivity of the receiver, whereby it may be placed in such operating condition that interference of the "adjacent channel" type is minimized.

10. In a radio receiving system, a high frequency amplifier, an audio frequency amplifier, means for concurrently controlling each of said amplifiers, said means being responsive to incoming signals, and including an automatic volume control electric discharge device having an output circuit, a coupling impedance in said output circuit for applying controlling potentials to said high frequency amplifier, an electric discharge amplifier device for controlling the damping and energy transfer through said high frequency amplifier and the fidelity characteristics of both of said amplifiers simultaneously, and manually controllable means for gradually connecting the output circuit of said automatic volume control device with said last named electric discharge control device for applying controlling potentials thereto in response to variations in signal strength.

11. In a radio receiving system, the combination with a high frequency amplifier and automatic volume control means connected therewith, of an electric discharge device connected with said amplifier to control inter-stage coupling means therein, means connected with said amplifier to control the damping and energy transfer therethrough, said last named means being connected with an output circuit of said electric discharge control device, and means for gradually changing the automatic volume control connection from the amplifier to the input circuit of said electric discharge control device.

12. In a radio receiving system, the combination with a high frequency amplifier, an audio frequency amplifier, and automatic volume control means for said first named amplifier, of an electric discharge device connected with said first named amplifier to control inter-stage coupling means therein, means connected with said first named amplifier to control the damping and energy transfer therethrough, said last named means being connected with an output circuit of said electric discharge control device, means for gradually changing the automatic volume control connection from the amplifier to the input circuit of said electric discharge control device, and means connected with the output circuit of said electric discharge control device for controlling the response characteristic of said audio frequency amplifier.

13. In a radio receiving system, the combination with a high frequency amplifier, an audio frequency amplifier, and automatic volume control means connected therewith, of an electric discharge device connected with said amplifier to control inter-stage coupling means therein, a plurality of electric discharge devices having anode circuits connected with said amplifier to control the damping and energy transfer therethrough, said last named devices having control electrodes connected with an output circuit of said electric discharge control device, and means for gradually changing the automatic volume control connection from the amplifier to the input circuit of said electric discharge control device.

14. In a radio receiving system, the combination with a high frequency amplifier, an audio

frequency amplifier, and automatic volume control means connected with said first named amplifier, of coupling means in said high frequency amplifier including a pair of coupled tuned circuits, an electric discharge device having a control electrode and having an output anode connected with one of said tuned circuits whereby the space current path thereof is substantially in shunt thereto, and means for connecting said automatic volume control means with the control electrode of said last named electric discharge device.

15. In a radio receiving system, the combination with a high frequency amplifier, an audio frequency amplifier, an automatic volume control means connected with said first named amplifier, of coupling means in said high frequency amplifier including a pair of coupled tuned circuits, an electric discharge device having a control electrode and an output anode connected with one of said tuned circuits whereby the space current path thereof is substantially in shunt thereto, an impedance device in circuit with said anode and means responsive to controlling potentials derived from said impedance device for controlling the damping and energy transfer through the circuits of said high frequency amplifier and the response characteristic of said audio frequency amplifier, an impedance device for coupling said automatic volume control means with the high frequency amplifier, a second impedance means for coupling said automatic volume control means with the control electrode of said last named electric discharge device, and a manually operable potentiometer means for selectively connecting said automatic volume control means with either of said last named impedance devices.

16. In a radio receiving system, a signal amplifier including a plurality of electric discharge amplifier devices, means for connecting said devices in cascade relation, means providing an automatic bias control circuit for said devices, means for controlling the damping and energy transfer of signals between said amplifier devices including a tunable input circuit for one of said devices and an electric discharge device having its space current path connected substantially in parallel with said circuit, an automatic volume control device of the electric discharge type, said device being connected with the signal channel to receive controlling potentials therefrom, an impedance device in a control circuit for one of said last named devices, a second impedance device in a sensitivity control circuit for said amplifier devices, and potentiometer means for gradually connecting said automatic volume control device selectively from one to the other of said impedance devices.

17. In a radio signal receiving system, the combination of a plurality of electronic amplifier devices, coupling means between at least two of said devices comprising a pair of coupled tuned circuits, an electronic device providing a variable impedance in parallel with one of said tuned circuits thereby to vary the selectivity of said system inversely with the impedance of said device, automatic volume control means for said electronic amplifier devices, a coupling network between said automatic volume control means and the said amplifier devices including a variable impedance device providing a variable connection between the automatic volume control means and said electronic control device.

18. In a radio receiving system, the combina-

tion with a high frequency amplifier, an audio frequency amplifier, and automatic volume control means for said first named amplifier, of an electric discharge device connected with said first named amplifier to control inter-stage coupling means therein, means for gradually changing the automatic volume control connection from the amplifier to the input circuit of said electric discharge control device, and means connected with the automatic volume control means for controlling the response characteristic of said audio frequency amplifier.

19. In a radio receiving system, the combination with a high frequency amplifier, an audio frequency amplifier, and automatic volume control means connected with said first named amplifier, of coupling means in said high frequency amplifier including a pair of coupled tuned signal circuits, an electric discharge device having a control electrode and an output anode connected with one of said tuned circuits whereby the space current path thereof is substantially in shunt thereto, means for connecting said automatic volume control means with the control electrode of said last named electric discharge device, and means responsive to said automatic volume control means when so connected for simultaneously controlling signals supplied to said audio frequency amplifier.

20. In a radio receiving system, the combination of a plurality of electronic amplifier devices, automatic means for controlling the gain in said amplifier devices, signal conveying coupling means between at least two of said devices, means for varying the selectivity of said coupling means including an electronic control device connected with said automatic gain controlling means, an audio frequency amplifier, means for applying signals from said first named amplifier devices to said last named amplifier, and means connected with and controlled by said automatic gain controlling means for controlling the audio frequency response characteristic of said last named amplifier.

21. In a radio receiving system, the combination of a plurality of electronic amplifier devices, coupling means for said amplifier devices, signal controlled means for deriving control potentials varying in opposite sense, means for utilizing said control potentials to vary the selectivity of at least two of said coupling means in the same sense, audio frequency amplifier means for said system, and means for utilizing one of said control potentials to vary the frequency characteristic of said last named amplifier means.

22. In a radio receiving system, the combination of a plurality of electronic amplifier devices, coupling means for said amplifier devices, signal controlled means for deriving control potentials varying in opposite sense, means for utilizing said control potentials to vary the selectivity of at least two of said coupling means in the same sense, means for utilizing one of said control potentials to vary the signal gain through said receiving system, and additional means responsive to operation of said gain controlling means for varying the audio frequency output characteristic of said system.

23. In a radio receiving system, in combination with a signal amplifier, means for simultaneously varying the gain and selectivity of said amplifier in response to variations in signal strength, and additional means for varying the audio frequency output characteristic of said system connected

with said first named means for simultaneous control thereby.

24. In a radio receiving system, the combination with a signal amplifier including a plurality of electronic amplifier devices, of means for simultaneously controlling the gain and selectivity of said amplifier in response to variations in signal strength, said means including a source of signal variable biasing potential for said amplifier devices, a signal variable impedance in shunt with the signal channel of said amplifier, means providing an audio frequency amplifier channel for receiving signals from said first named amplifier, and means for controlling the signal transmission through said channel in response to operation of said first named means.

25. In a radio receiving system, the combination of a signal amplifier comprising a plurality of coupled tuned electronic amplifier stages, means responsive to variations in signal amplitude for simultaneously varying the tuning characteristic of certain of the stages of said amplifier and the effective coupling between at least two of said stages to vary the selectivity and the fidelity of said receiving system, and means simultaneously controllable with said last named means in response to signal amplitude variations for varying the audio frequency output characteristic of said system in accordance therewith.

26. In a radio receiving system, the combination of a signal amplifier comprising a plurality of coupled tuned electronic amplifier stages, means responsive to increased signal amplitude for simultaneously broadening the tuning of certain of the stages of said amplifier and increasing the effective coupling between at least two of said stages to increase the fidelity of response to said receiving system, audio frequency amplifier means for said system, and means for simultaneously increasing the fidelity of said audio frequency amplifier means in response to increased signal amplitude.

27. In a radio receiving system, the combination of a signal amplifier comprising a plurality of coupled tuned electronic amplifier stages, means responsive to increased signal amplitude for simultaneously broadening the tuning of certain of the stages of said amplifier and increasing the effective coupling between at least two of said stages to increase the fidelity of response of said receiving system, audio frequency amplifier means for said system, means for simultaneously increasing the fidelity of said audio frequency amplifier means in response to increased signal amplitude, automatic volume control means for said signal amplifier, and means providing a controllable connection between said automatic volume control means and said fidelity control means.

28. In a radio receiving system, the combination of a signal amplifier comprising a plurality of coupled tuned amplifier stages, automatic volume control means for applying variable gain controlling potentials to certain of the amplifier

stages in response to variations in signal strength, means for simultaneously broadening the tuning of and increasing the coupling between certain of said amplifier stages in response to increased signal strength thereby to increase the fidelity and to decrease the selectivity of said signal amplifier, audio frequency amplifier means for said system, means for increasing the fidelity of response of said audio frequency amplifier means simultaneously with said first named means in response to increased signal strength, and means providing a variable control connection between said automatic volume control means and said first and last named means.

29. In a radio receiving system, the combination of a signal amplifier comprising a plurality of coupled tuned electronic amplifier stages, an audio frequency amplifier, automatic volume control means for said first named amplifier and means controllable by said automatic volume control means for broadening the tuning of and increasing the coupling between certain of the stages of said first named amplifier and simultaneously increasing the high frequency response characteristic of said audio frequency amplifier in response to increased signal strength.

30. In a radio receiving system, the combination of a signal amplifier comprising a plurality of tuned coupled signal circuits, a plurality of separate signal amplifier circuits having differing audio frequency output characteristics, and means for simultaneously broadening the tuning of and the coupling between certain of the stages of said first named amplifier and the gain through one of said separate amplifier circuits in response to increases in the amplitude of received signals.

31. In a superheterodyne radio receiving system, the combination with an intermediate frequency amplifier and automatic volume control means therefor, of audio frequency amplifier means having a plurality of frequency discriminating channels, a separate intermediate frequency amplifier for at least one of said channels, means for simultaneously broadening the tuning of and increasing the coupling between certain of the signal conveying circuits of said first named intermediate frequency amplifier, and increasing the gain through said last named intermediate frequency amplifier, and means providing an automatic volume control connection whereby said last named means is operable in response to an increase in the amplitude of received signals.

32. In a superheterodyne receiver, the combination with an intermediate frequency amplifier and an audio frequency amplifier, of automatic volume control means responsive to increases in signal amplitude for simultaneously increasing the fidelity through each of said amplifiers, and means for automatically controlling the gain through said first named amplifier in response to variations in signal amplitude.

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