

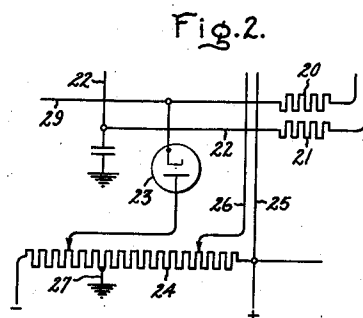
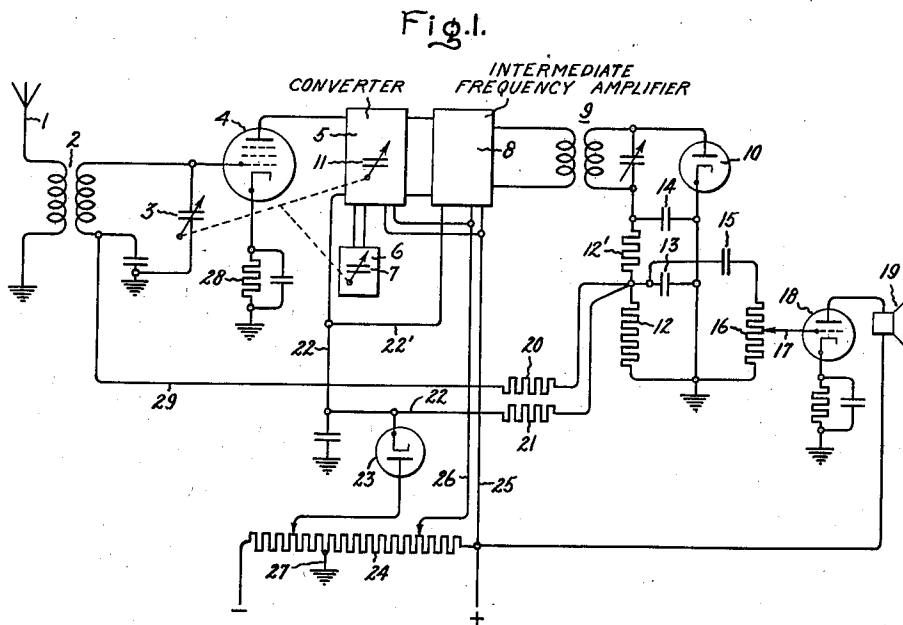
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AUTOMATIC GAIN CONTROL SYSTEM

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AUTOMATIC GAIN CONTROL SYSTEM

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1 Claim. (Cl. 179—171)

My invention relates to automatic gain control systems such as are commonly employed in radio receivers and it has for one of its objects to effect certain improvements therein with respect to avoidance of distortion, and overloading of the discharge devices employed in the system.

A further object of my invention is to provide an automatic volume control system in which the effectiveness of the control on the different discharge devices is differently varied in response to the intensity of the received signal and in such a way as to reduce distortion due to overloading of any of the discharge devices.

Another object of my invention is to provide an automatic volume control system in which the automatic gain control action on certain of the discharge devices substantially ceases when the intensity of the received signal exceeds a predetermined value, while it becomes even more effective on certain of the other discharge devices.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claim. My invention itself however both as to its organization and method of operation together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 represents an embodiment of my invention and Fig. 2 illustrates a modification thereof.

Referring to the drawing I have shown therein, a radio receiver comprising an input circuit which includes an antenna 1, and the primary of a transformer 2. The secondary winding of this transformer is tuned to the received frequency by the usual tuning condenser 3 and is connected between the grid and cathode of a radio frequency amplifier 4. The output from the radio frequency amplifier 4 is supplied to the usual converter 5 of the radio receiver where the received radio frequency currents are heterodyned with oscillations produced by a local oscillator 6, the frequency of which is controlled by a condenser 7 thereby to produce currents of the so-called intermediate frequency. These currents are supplied through intermediate frequency amplifier 8 to the input 9 of a diode detector 10. The circuits as thus far described are those of the conventional superheterodyne radio receiver having uni-controlled tuning condensers 3, 7, and 11 operable to tune the receiver to different stations in the usual way. My invention, however, is of course applicable to any type of

receiver and is by no means limited to one of the superheterodyne type.

The circuit of the diode 10 includes resistances 12 and 12' and condensers 13 and 14. The time constant of these resistors and condensers is, of course, such that audio frequency potentials are produced upon the resistance 12 which faithfully represent the modulations on received carrier wave. Condensers 13 and 14 and resistance 12' also operate as a filter to suppress the currents of the carrier frequency. Audio frequency potentials which appear upon resistance 12 are supplied through condenser 15 to the volume control potentiometer 16 having variable contact 17 which is connected to the grid of an audio amplifier 18. The output from the latter amplifier may, if desired, be supplied through additional amplifier equipment, or to a suitable signal reproducing apparatus, such as the loud speaker 19.

The unidirectional potential which exists upon resistance 12 is also supplied through resistance 20 and conductor 29 to the grid of radio frequency amplifier 4 and through resistance 21 and conductor 22 to the grids of converter 5 and through conductor 22' to the grids of the various intermediate frequency amplifiers 8 thereby to produce automatic volume control action. That is, as the received signal intensity increases, the unidirectional potential upon resistance 12 increases and thus the control grids of the discharge device 4 and the discharge devices in the converter 5 and intermediate frequency amplifier 8 are driven increasingly negative with respect to their cathodes. This action, in turn, reduces the amplification of the discharge devices and thus tends to maintain a constant signal output from the receiver.

It frequently happens, however, in the operation of systems as thus far described in the presence of strong signals that the bias of certain of the discharge devices do not increase sufficiently rapidly to prevent overloading of those discharge devices. For example, it will be seen that in the circuit as thus far described, the bias voltage is applied equally to each of the different discharge devices. Since the received signal is amplified in the earlier stages it may occur that in the presence of strong signals the bias on one or more of the later amplifiers in the cascade arrangement will not be sufficiently increased by the automatic volume control system to avoid distortion due to overloading. In accordance with my invention, means are provided whereby the automatic volume control

system operates normally until the signals attain a certain high intensity. Beyond this point the automatic volume control action becomes concentrated upon the amplifier 4, the grid bias of which is greatly increased, thus more rapidly reducing the amplification of this amplifier in response to any further increases in the received signal. In this way the intensity of the received currents supplied to the circuit of the amplifiers 5 and 8 is greatly reduced and the resulting distortion is materially reduced or eliminated. Thus overloading of devices 4 and 8 is avoided by the greatly reduced amplification of amplifier 4 and overloading of amplifier 4 is avoided by the greatly increased grid bias. The means whereby this result is effected comprises a diode 23 having its cathode connected to the conductor 22 and its anode connected to a source of negative potential. This source may comprise the usual bleeder resistance 24 which is provided in the power supply system for the receiver and which supplies anode potential through conductor 25 to the different discharge devices of the receiver and screen grid potential through conductor 26 to the different discharge devices of the receiver. An intermediate point 27 on this resistance is connected to ground as are the cathodes of the radio frequency amplifier 4, converter 5, and intermediate frequency amplifiers 8. This connection of the cathodes to ground may be made directly or through bias resistors as desired, as shown at 28 in the cathode return circuit of the radio frequency amplifier 4. The anode of the diode is connected to a point on the resistance 24 which is sufficiently negative with respect to ground to prevent any current from flowing through the diode until the received signals are of such high intensity that if substantial further increase occurs, distortion is likely to result due to the overload above mentioned. Then, upon any further increase in the signal intensity the conductor 22 becomes sufficiently negative to cause the cathode of diode 23 to become negative with respect to the anode thereof. This diode then becomes conducting and greatly reduces or prevents any further increase in the negative grid potential on the converter 5 or the intermediate frequency amplifiers 8. That is the current in the diode flowing through resistance 21 produces sufficient drop in potential thereon to maintain conductor 22 at substantially constant potential. The amplification of the discharge devices of the converter 5 and intermediate frequency amplifier 8 is thus no longer reduced upon increase in intensity of the received signal with the result that the potential on resistance 12 now increases more rapidly than before with respect to the intensity of signals received in the antenna 1. This more rapidly increasing unidirectional potential, however, is still applied with its full effect through resistance 20 to the control grid of amplifier 4, thus more rapidly reducing the amplification of this discharge device with respect to further increases in intensity of the received signal. Accordingly the intensity of current supplied to the converter does not now increase so rapidly with respect to the intensity of currents received on the antenna 1 and is thus held at a more nearly constant amplitude during the variations in intensity beyond the predetermined value referred to.

Thus, in effect, when the signal intensities exceed the predetermined value, the distribution of

the automatic volume control potential upon the grids of the different controlled discharge devices is varied so that the automatic volume control potential becomes less effective upon the subsequent amplifiers and more effective upon the first amplifiers of the system, thus reducing the likelihood of distortion.

In Fig. 2 I have shown a modification of my invention in which the cathode of diode 23 is connected not to conductor 22 as in Fig. 1, but to conductor 29. Otherwise the circuit of Fig. 2 is the same as that of Fig. 1 only so much being included in the figure as is necessary to illustrate the modification. Of course the point of connection of the anode of diode 23 to bleeder 24 may be adjusted as desired.

This latter modification of my invention may be especially desirable in those cases where the electron discharge device 4 is one in which the anode current grid voltage characteristic is such that the tube cuts off at low grid voltages. Tubes having such characteristics are now known on the market as, for example, the RCA 1851, or RCA 1852, type, which tubes have been proposed for use as radio frequency amplifiers. When employing such a discharge device the potential on the anode of diode 23 is so adjusted that this diode becomes conducting in time to prevent the grid voltage on the discharge device 4 from reaching the knee of the characteristic. That is, the diode stops the increase in negative grid bias on the tube 4 just short of the cut-off of the tube. At the same time the grid voltage on the other discharge devices of the system continues to increase at a faster rate than before, due to the absence of automatic volume control potential applied to the discharge device 4. This system thus has a decided advantage in reducing the likelihood of distortion.

While I have shown particular embodiments of my invention, it will, of course, be understood that I do not wish to be limited thereto since different modifications both in the circuit arrangement and in the instrumentalities employed may be made without departing from the spirit and scope of my invention. I, therefore, contemplate by the appended claim to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

In combination, a pair of cascade connected grid controlled amplifiers, the current in the first of said amplifiers cutting off when its grid becomes more negative than a certain low negative voltage relative to the cathode, means to supply to the grids of each of said amplifiers a bias potential negative with respect to the cathodes thereof, the bias potential supplied to the grid of the first amplifier in the cascade connection being less than said certain potential, said potentials becoming increasingly negative in response to increase in intensity of signal amplified by said amplifiers, means to prevent increase in said potential supplied to the grid of said first amplifier before said certain potential is reached and to increase the rapidity of increase in the potential on the grid of said second amplifier with further increase in intensity of signal amplified by said amplifiers whereby said first amplifier is prevented from cutting off by reason of said bias potential and the second amplifier is prevented by its increased bias from overloading.

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