

Sept. 14, 1937.

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2,093,095

AUTOMATIC VOLUME CONTROL

Original Filed Feb. 9, 1935

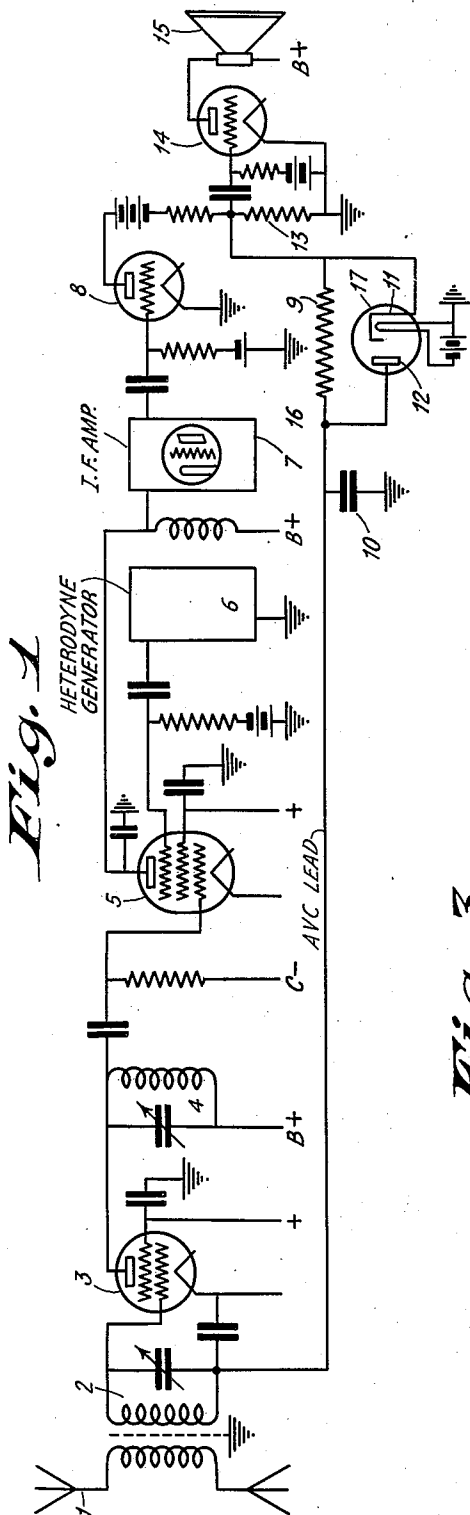


Fig. 2

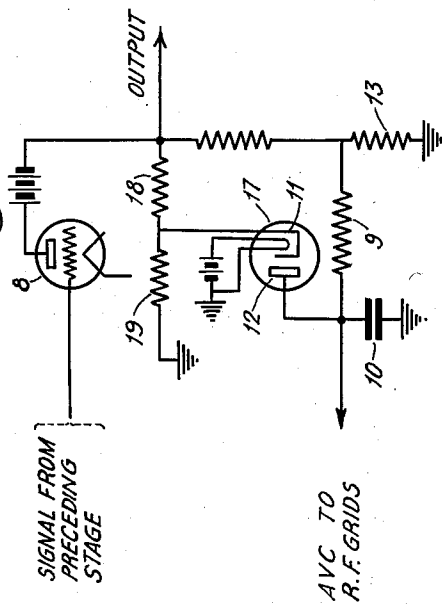
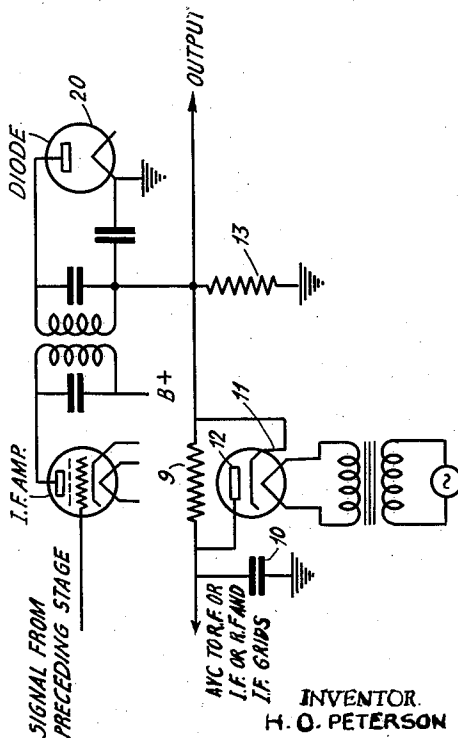


Fig. 3



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2,093,095

AUTOMATIC VOLUME CONTROL

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Application February 9, 1935, Serial No. 5,734
Renewed September 22, 1936

5 Claims. (Cl. 250—20)

This invention relates to radio receiving systems and more particularly to a method of and means for automatically controlling the volume or intensity of received signals at a uniform level.

It is well known, in receivers, to use time constant circuits comprised of resistance and capacity to control the speed of operation of automatic volume control devices. In general, these time constant circuits function to control the bias applied to the grid of an electron discharge device after the lapse of an interval approximately anywhere between one-fifth and ten seconds. If the signal fades slowly down to a low value of intensity, the automatic volume control action through the time constant circuit operates to compensate the loss of signal intensity by changing the bias on the grid and thus increasing the gain of the receiver so as to maintain a constant output level. On the other hand, any sudden increase in signal intensity will cause the automatic volume control device to decrease the gain of the receiver in order to maintain the same constant output level. A difficulty which arises in such arrangements occurs when signal fading becomes fairly rapid, at which time there are experienced sudden abnormally high bursts of output volume in the interval immediately succeeding deep fading of the signal. This difficulty is due to the fact that the time constant circuit operates at a slower rate than the rate at which the signal increases in strength after fading; in other words, the gain in the receiver is not compensated fast enough to maintain constant output level and the output may temporarily be at a very high and abnormal value until the automatic volume control acting through the time constant circuit succeeds in reducing the gain to the proper value.

The present invention overcomes the above mentioned difficulty and provides a system wherein the speed of operation of the automatic volume control device is momentarily increased when the strength of the incoming signal suddenly increases.

A feature of the present invention lies in the use of a momentarily operative electron discharge device in shunt to a resistance in the time constant circuit. The device is responsive only to sudden large increases in voltage across the resistance so as to provide a path of low impedance through which the capacity of the time constant circuit can be rapidly charged to a value sufficient to restore the output level to normal.

Referring to the drawing, Fig. 1 illustrates diagrammatically a receiver embodying one form of the invention, and Figs. 2 and 3 illustrate modifications of the automatic volume control circuit of Fig. 1.

The receiving system of Fig. 1 is of the double detection or super-heterodyne type in which an intermediate frequency carrier wave is produced

by demodulation of the incoming wave with an auxiliary wave locally generated. The incoming waves are received by antenna 1, and impressed through a tuned circuit 2 upon the control grid of a stage of high frequency amplification 3, from whose tuned output circuit 4 the amplified oscillations are fed to a stage of detection 5 where an auxiliary wave is also supplied from a local heterodyne source 6. Both the incoming signal waves and the auxiliary wave combine in detector 5 to produce a beat or intermediate frequency which is supplied to selective intermediate frequency amplifier 7, the output product of which is delivered to the negatively biased grid of the second stage of detection 8. In well known manner, the signal waves impressed on detector 8 cause plate current to be drawn through resistance 13 and the modulation frequency to appear on the grid of amplifier 14 which amplifies the low frequency currents and supplies the amplified current to the signal reproducer 15, herein illustrated as a loudspeaker.

The current through resistance 13, caused by the signal waves impressed on the input of detector 8, produces a voltage drop which is transferred through resistance 9 of the time constant circuit to charge condenser 10 thereof, whereby point 16 assumes a negative value. The grid of radio frequency amplifier 3 is connected to this point which supplies the grid bias for automatically controlling the volume of the system. It will be apparent that more current will flow through resistances 9 and 13, and that point 16 will be more negative as stronger signals are received, in consequence of which the negative grid bias is increased and the gain in amplifier 3 decreased, thus tending to keep the plate current through resistance 13 at a constant value. The time constant of the automatic volume control feature is determined by the size of resistance 9 and condenser 10.

In accordance with the present invention, there is provided in shunt of resistance 9, an electron discharge device 17 comprising cathode 11 and anode 12 enclosed within an envelope which may be either evacuated or filled with gas or vapor.

The characteristic of electronic device 17 is such that as the voltage between anode and cathode is increased, the impedance of the path between 12 and 11 is decreased. Consequently when the signal strength suddenly increases after a prolonged period at a low value, the sudden increase of voltage across resistor 13 engenders a sudden abnormally large voltage across resistor 9, upon the occurrence of which the path between electrodes 12 and 11 of device 17 becomes of low impedance and enables condenser 10 to charge rapidly to a value sufficiently negative to quickly restore the normal output level. In this way the interval of abnormal output may be

reduced to such a short interval as to be unobjectionable.

Although the AVC lead from condenser 10 is shown connected to the grid of the first stage of amplification, it will be understood, of course, that this showing is merely by way of illustration and that this lead may, if desired, connect with the grids of other stages as well, also the automatic control units may be connected to the output of other stages than detector 8.

Fig. 2 is a modification of Fig. 1 and for the sake of simplicity merely illustrates the pertinent details of the automatic control feature alone. Vacuum tube 8 herein represents any rectifier in the system situated in such part of the circuit that the rectified voltage amounts to several volts. The operation of this circuit is quite similar to that of Fig. 1, with the advantage that a certain amount of flexibility is provided by the additional voltage dividing circuit 18, 19. In the system of Fig. 2, the automatic control time constant circuit 9, 10 derives its voltage from the voltage drop in resistance 13, which is transferred to condenser 10 through resistance 9. The time constant here also is determined by resistance 9 and condenser 10. Similar automatic volume controlling voltage is simultaneously produced across resistance 19 and the ratio between resistances 18 and 19 may be adjusted so that the voltage drop in resistance 19 may be greater or less than the voltage drop in resistance 13. Any sudden increase in amplitude in the output of electron discharge device 8 will appear across resistance 19 and will produce a path of low impedance between electrodes 11 and 12, thus immediately charging condenser 10 through device 17.

If desired, a fixed value of potential may be inserted in series with device 17 to give a required operating condition.

Figure 3 shows a further modification illustrating the use of a diode 20 as a rectifier instead of a grid type of rectifier.

It should be understood that the invention is not limited to the precise arrangement of parts shown, since various other forms of shunting electron discharge devices, such as mercury rectifier tubes, ordinary vacuum tubes, and grid controlled glow tubes, known by the trade-name "Thyratron", may be employed.

What is claimed is:

1. In a receiving system, an amplifier adapted to amplify the incoming waves, means for rectifying the products of said amplifier, a time constant circuit including a resistance and a condenser in circuit with said means for impressing a potential obtained from said rectified waves upon said amplifier to control its efficiency, and an electron discharge device in shunt with said resistance and responsive to a sudden large increase in the intensity of the incoming waves for providing a path of low impedance across said resistance, whereby said condenser is more rapidly charged to increase the speed of control over said amplifier.

2. In a wave receiver, an automatic volume control system including a time constant element for controlling the degree of amplification of said receiver in an inverse manner as the amplitude of the received waves varies, an electron discharge device of the diode type in shunt with

said element and responsive only to sudden large changes in amplitude for increasing the speed of operation of said control system, and means including a diode detector adapted to be fed with amplified energy from said receiver for impressing a variable control potential across said time constant element and across said discharge device which is in shunt therewith.

3. In a wave receiving system of the type in which an incoming carrier wave is first amplified and then demodulated with a locally generated heterodyne wave to produce a beat wave of a different frequency, a rectifying device for rectifying the beat waves, a resistance in circuit with the output of said rectifying device across which are produced the modulations of said incoming carrier wave, a translator coupled to said resistance, a series circuit of another resistance and a condenser connected between a point on said first resistance and ground, whereby said condenser is charged in accordance with the variations in modulation appearing across said first resistance, a connection from the junction point of said condenser and its series coupled resistance to an element in said system for automatically controlling the degree of amplification of said system, and a two electrode electron discharge device in shunt with said last resistance and responsive to a predetermined sudden increase in amplitude of the rectified waves to produce a path of low impedance across said last resistance, whereby the charge on said condenser can more rapidly follow the variations in modulation appearing across said first resistance.

4. In a radio receiving system, an incoming signal wave amplifier, means including a grid-controlled electron discharge device for rectifying the products of said amplifier, means including an impedance circuit between two output electrodes of said grid-controlled electron discharge device for deriving potentials which vary with the magnitude of the rectified waves, means including a time constant circuit having a resistor connected at one end to an intermediate point on said impedance circuit, and at the other end to a point on the input circuit of said amplifier for controlling the efficiency of said amplifier, a capacitor connected to the last mentioned end of said resistor and in circuit with the cathode of said electron discharge device, and an electron discharge device of the diode type in shunt with said resistor.

5. In a signal reception system, a signal transmission tube, a detection tube including an impedance in its space current path across which is developed a direct current voltage varying in magnitude with signal intensity variation, an automatic gain control connection between a gain control electrode of the transmission tube and a point on the impedance which becomes more negative with signal intensity increase, a resistive element included in said control connection, a device of uni-directional conductivity in shunt with the resistive element, and a terminal of the said device being connected to said point whereby the device becomes conductive and causes current to flow through the resistive element when said point suddenly assumes a highly negative potential.

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