

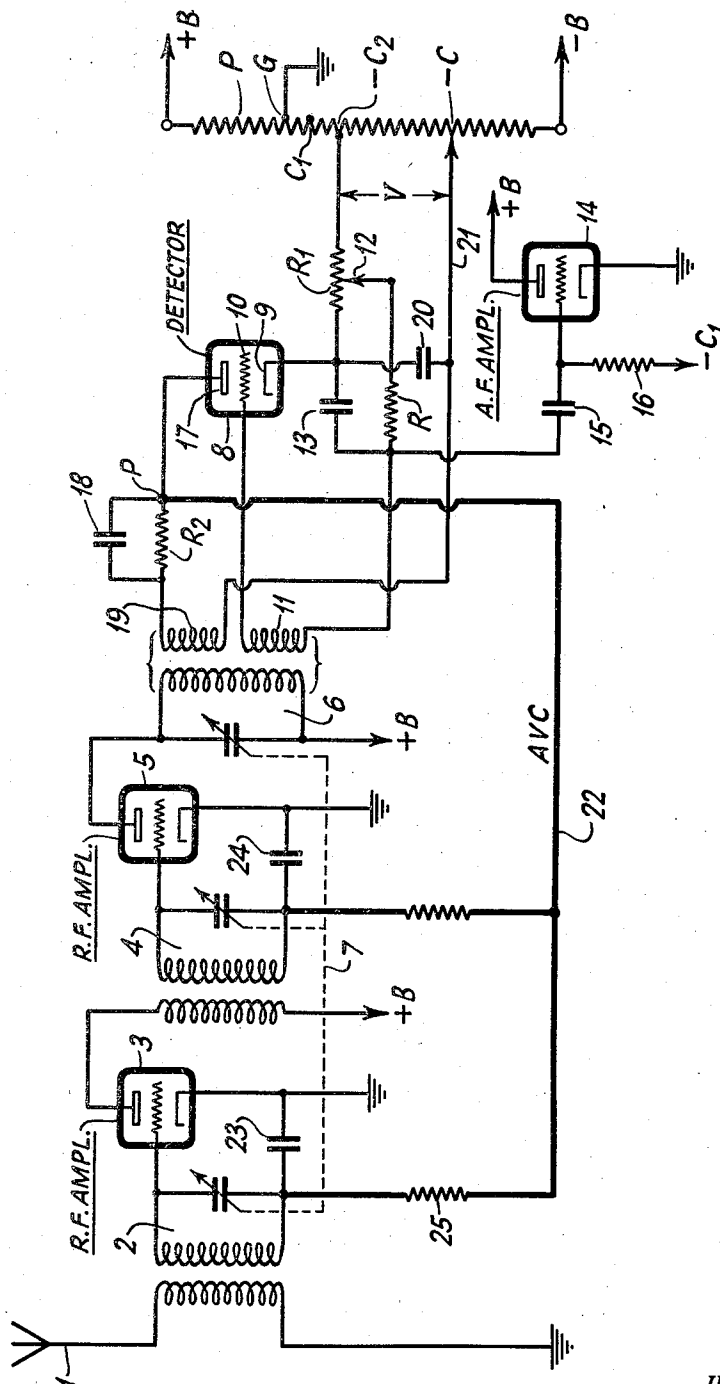
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R. A. WEAGANT

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AUTOMATIC VOLUME CONTROL CIRCUIT

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BY

INVENTOR.
ROY A. WEAGANT

ATTORNEY.

UNITED STATES PATENT OFFICE

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AUTOMATIC VOLUME CONTROL CIRCUIT

Roy A. Weagant, Douglaston, Long Island, N. Y.,
assignor to Radio Corporation of America, a
corporation of Delaware

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My present invention relates to automatic volume control (AVC) circuits, and more particularly to an AVC circuit adapted to regulate both amplification and detection with the electrodes of a triode.

One of the main objects of my present invention is to utilize the cathode, grid and plate of a triode to provide a detector and an AVC rectifier; the rectifier functioning to decrease the radio amplifier gain when the signals increase in amplitude above a desired level, and the detection efficiency being concurrently decreased.

Still other objects of my invention are to improve generally the simplicity and efficiency of receivers provided with AVC circuits; and more especially to provide an AVC arrangement which is economically 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, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the drawing in which I have indicated diagrammatically a circuit organization whereby my invention may be carried into effect.

Referring now to the drawing, there is schematically shown a receiver of conventional construction embodying my invention. The signal collector 1, which can be a grounded antenna circuit, is coupled to the tunable input circuit 2 of the radio frequency amplifier tube 3. The cathode of tube 3 is at ground potential; the plate of the tube is connected to a proper positive potential point B on the customary voltage supply bleeder resistor P. An intermediate point G of the latter is at ground potential.

The plate of tube 3 is coupled to the tunable input circuit 4; the latter is disposed between the input electrodes of the second radio amplifier tube 5. The cathode of the latter is at ground potential; the plate circuit of tube 5 may include the tunable network 6. The dotted line 7 denotes the customary mechanical coupling between the rotors of the variable condensers used in tunable circuits 2, 4, 6. The amplifiers 3 and 5 can denote the usual networks of a super-heterodyne receiver, if desired, prior to the second detector. The tubes 3 and 5 can be screen grid or pentode tubes.

The receiver detector comprises a triode 8; the cathode 9 is connected to a point C₂ on P by a resistor R₁. The control grid 10 is connected to a desired point on resistor R₁ through a path

including coil 11, resistor R and adjustable tap 12. The coil 11 is reactively coupled to the output circuit of amplifier 5; a radio frequency by-pass condenser 13 is connected between the cathode and the grid end of resistor R. Audio voltage developed across the load resistor R is impressed on the audio amplifier 14; the audio coupling condenser 15 is used to couple the grid of tube 14 to the load resistor R. The usual leak resistor 16 may connect the grid of tube 14 to a negative point C₁ on P. The output of tube 14 may be further amplified, and finally reproduced in a loudspeaker.

The plate 17 of tube 8 is connected to the cathode through a path including load resistor R₂, shunted by a radio frequency by-pass condenser 18, coil 19 and condenser 20. The coil 19 is reactively coupled to circuit 6. The adjustable tap 21 connects the junction of coil 19 and condenser 20 to a negative point C on P. The potential difference between points C and C₂ on P is designated by the reference letter V. The lead 22, designated as the AVC connection, connects the low potential end of each input circuit 2 and 4 to the anode end of resistor R₂. The direct current blocking condensers 23 and 24 connect the low potential ends of each of circuits 2 and 4 to the grounded cathodes. Resistors 25 are included in the lead 22 to suppress the pulsating voltage components of rectified voltage developed across resistor R₂.

The operation of the tube 8 and its associated networks will now be explained. It should be understood that the receiver can be one operating in the broadcast range, say 500 to 1500 k. c. The signal voltage developed across circuit 6 is impressed on each of coils 19 and 11. The detection action by the circuit included between grid 10 and cathode 9 provides the audio voltage; the rectification by the circuit between anode 17 and cathode 9 provides the direct current voltage across R₂ used for AVC. The normal bias for the amplifier grids is the voltage between ground and point C on bleeder P. That is to say, when no signals are received the amplifier tubes 3 and 5 are operating at maximum gain; the negative potential not being developed across resistor R₂. In this no-signal condition there is no plate or grid current flow in tube 8.

When weak signals are received, and the amplitude of which signals is less than the magnitude of the delay bias V, no plate current flows in tube 8. If grid current flows, however, it tends to render the detector cathode 9 more positive than before, thus adding a little more delay volt-

age to the bias V. However, it should be noted that this extra delay voltage is not added to the bias applied to the amplifier grids. There is no delay bias applied to the grid 10, hence the signal detection is normal. Therefore, it will be seen that for weak signal reception audio voltage is fed to the amplifier 14, while the AVC rectification is delayed.

Upon the received signal carrier amplitude exceeding the delay voltage applied to plate 17, current flows through the resistor R₁, as well as through resistor R₂. The direct current voltage developed across resistor R₂ is employed to increase the negative bias on the signal grids of amplifier tubes 3 and 5, and it will be noted that the negative voltage applied through lead 22 is added to the voltage V. Concurrently, the grid 10 is biased negatively with respect to the cathode 9, since the grid 10 is connected through resistor R and tap 12 to an intermediate point on resistor R₁. This biasing of grid 10 reduces the detection efficiency of the rectifier comprising grid 10 and cathode 9 and the associated circuit.

By a suitable choice of a magnitude of resistor R₁, and suitable positioning of tap 12 on the latter, various effects may be produced. With the tap 12 positioned adjacent the cathode end of resistor R₁, the grid circuit acts as a simple diode, while the plate circuit produces an additional amplifier bias that increases linearly with the excess of signal voltage over the bias V. On the other hand, with the tap 12 adjusted to the extreme right end of the resistor R₁, the plate current through the resistor may bias the grid 10 so that no rectification takes place in the grid circuit beyond a certain signal strength dependent upon the ratio of signal voltages applied to the coils 11 and 19. This can provide a silencing action for strong crashes of interference.

With this type of AVC circuit the automatic decrease of the amplifier gain will cooperate with the detector efficiency decrease so that the magnitude of the audio voltage delivered to the amplifier 14 is maintained substantially constant in spite of fading of the received carrier signal. A system of this type is of a special utility in connection with receivers of limited amplifier tubes, and where it is desired to have an efficient AVC system. It will be particularly noted that the AVC action is secured with an ordinary triode tube, and that the AVC action itself is of the delayed type.

While I have indicated and described a system 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 organization 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 combination with a tube of the type including a cathode, control grid and plate, a signal input circuit connected between the cathode and control grid to provide a diode detection circuit, said signal input circuit including impedance means for developing an audio current voltage from impressed signals, a second signal input circuit connected between the plate and cathode, said second circuit including impedance means for developing a direct current voltage from impressed signals, and impedance means, other than said two impedance means, common to said two input circuits for automatically controlling the detection efficiency of said cathode and control grid in response to current flow between said cathode and plate.

2. In a system as defined in claim 1, a source of direct current voltage, and means connecting said source between said cathode and plate in a manner such that the plate is biased to a predetermined negative voltage with respect to the cathode thereby to delay the development of said direct current voltage.

3. In a system as defined in claim 1, said common means comprising a resistor in said second circuit, and means providing a direct current voltage connection between said control grid and a point on said resistor such that the grid becomes increasingly negative with respect to the cathode as said current flows.

4. In combination with a source of modulated carrier signals, an electron discharge tube of the type including at least a cathode, control grid and plate, a signal circuit coupling said source to said cathode and plate, said signal circuit including a load resistor for developing a voltage from received signals, an impedance element disposed in the space current path between said cathode and plate, a second signal circuit coupled to said source and connecting the grid and cathode to provide a diode detector circuit, and a direct current voltage connection between said control grid and a point on said impedance such that space current flow through the latter results in negative biasing of the control grid.

5. In combination with a source of modulated carrier signals, an electron discharge tube of the type including at least a cathode, control grid and plate, a signal circuit coupling said source to said cathode and plate, said signal circuit including a load resistor for developing a voltage from received signals, an impedance element disposed in the space current path between said cathode and plate, a second signal circuit coupled to said source and connecting the grid and cathode to provide a diode detector circuit, a direct current voltage connection between said control grid and a point on said impedance such that space current flow through the latter results in negative biasing of the control grid, said source including a signal amplifier tube, and a gain control connection between said load resistor and said amplifier tube.

ROY A. WEAGANT.