April 25, 1939. J. E. BEGGS 2,156,078

RADIO RECEIVING APPARATUS

Filed Dec. 17, 1936

Fig. 1.

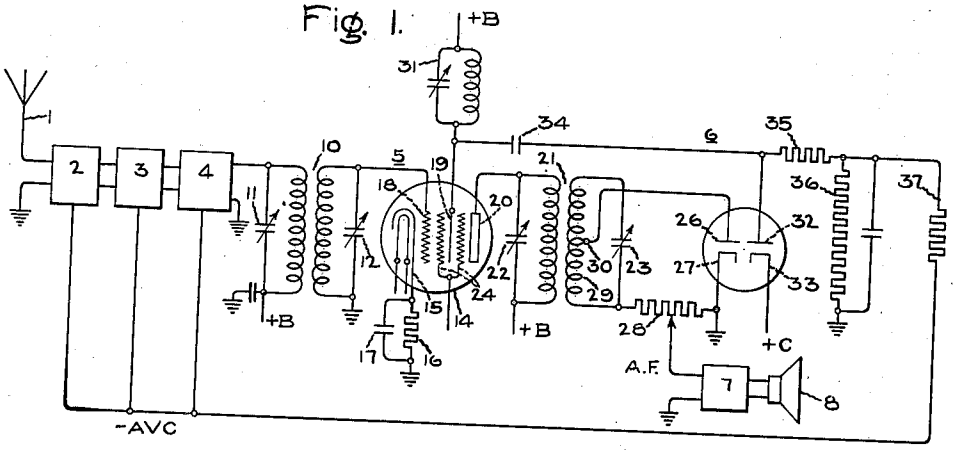


Fig. 2.

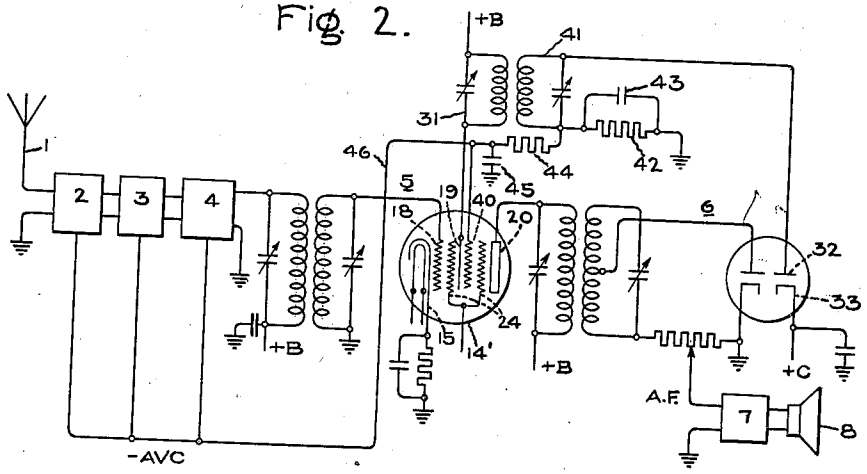


Fig. 3.

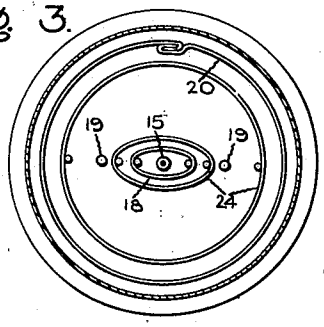
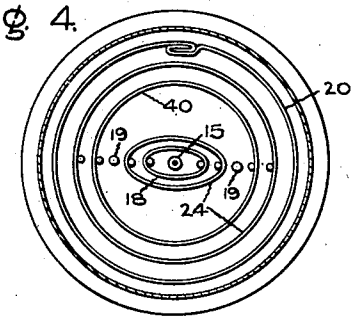


Fig. 4.



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RADIO RECEIVING APPARATUS

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8 Claims. (Cl. 250—20)

My invention relates to radio receiving apparatus and particularly to such apparatus wherein an automatic volume control voltage is produced.

In apparatus of this character heretofore commonly employed the automatic volume control has been produced by the same detector which produced the audio frequency. This has caused an objectionable loading of the detector and the production of a voltage for automatic volume control purposes which was unnecessarily high for the audio frequency circuit. In certain cases such objectionable loading of the detector has been avoided by the provision of a separate channel automatic volume control system which employs a separate amplifier from that by which the signal is amplified.

One object of my invention is the provision of improved apparatus of this character whereby the aforesaid objectionable loading of the detector may be avoided without the use of a separate amplifier. Another object of my invention is the provision of such apparatus in which less damping occurs than heretofore in the tuned circuit which supplies the detector. A further object is the provision of such apparatus in which, without the use of a separate automatic volume control amplifier, a more nearly uniform signal voltage is supplied to the detector when variations occur in the received signal voltage.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 is a circuit diagram illustrating one embodiment of my invention; Fig. 2 is a similar diagram illustrating a modification thereof; and Figs. 3 and 4 are cross-sectional views of the special form of amplifier represented diagrammatically in Figs. 1 and 2.

In Fig. 1 where I have shown my invention as forming a part of a superheterodyne radio receiving system, 1 is the antenna or pick-up device, 2 is the radio frequency amplifier stage, 3 is the detector and oscillator stage, 4 is the first intermediate frequency amplifier stage, 5 is the second intermediate frequency amplifier stage, 6 is the second detector stage, 7 is the audio frequency amplifier stage, and 8 is the loudspeaker.

The two stages 4 and 5 of intermediate frequency amplification are shown connected together by the coupling transformer 10, the primary and secondary windings of which are tuned to the intermediate frequency by the variable capacitors 11 and 12 respectively. The stage 5 comprises the special electron discharge amplifier 14 which has the cathode 15 connected with ground through the self-biasing resistor 16, shunted by the bypass capacitor 17, the main control grid 18 which connects with the secondary of the transformer 10, the auxiliary anode 19, and the main anode 20. This anode, which it will be noted controls only the audio frequency, connects with the detector 6 through the coupling transformer 21 whose primary and secondary circuits are tuned to the intermediate frequency by means of the variable capacitors 22 and 23 respectively. The amplifier 14 is also shown provided with the screen grid 24 having two parts as commonly employed.

The detector 6 comprises a diode having the anode 26, the cathode 27 and the diode load resistor 28. Inasmuch as the automatic volume control voltage is not derived from the detector, and since the voltage required by the audio frequency circuit is much less than that commonly supplied by the detector where the same also provides the automatic volume control voltage, the resistor 28 is relatively small in the present case. The detector also connects across only a fractional part of the secondary winding 29 of the transformer 21, the detector circuit being shown connected between the lower end of the secondary winding 29 and the intermediate tap 30 thereof. This tap is preferably so arranged that the impedance of the resistor 28 matches the impedance of that part of the secondary winding included in the detector circuit. As a result of this arrangement there results less damping on the tuned circuit which includes the transformer secondary, thus giving a more ideal selectivity characteristic.

The automatic volume control voltage is obtained through the tuned circuit 31 and is controlled by the output of the auxiliary anode 19. This anode 19 preferably comprises two spaced rods arranged between the two parts of the screen grid 24 and also between the control grid and the main anode, as shown, for example, by Fig. 3. The output of the auxiliary anode 19 like that of the main anode 20 is controlled by the control grid 18.

For converting the output of the auxiliary anode 19 into automatic volume control voltage I employ a second diode having the anode 32 and the cathode 33 which connects with a suitable source of positive voltage represented by C. This diode may be separate and distinct from the diode previously mentioned but I prefer to employ a doubled iode in which the two pairs of elements are contained in the same envelope as represent-

ed on the drawing. The anode 32 connects through the coupling capacitor 34 with the auxiliary anode 19 and through the filter resistor 35 with the upper end of the resistor 36, the lower end of which is grounded. The upper end of resistor 36 also connects by the conductor 37 with the stages 2, 3, and 4 to supply negative automatic volume control voltage thereto.

With the above described construction it will be seen that when the received signals are weak the output of the auxiliary anode 19 is small, hence the automatic volume control voltage is small and the gain in stages 2, 3, and 4 is large. As the signal strength increases the output of the auxiliary anode 19 also increases producing a greater negative automatic volume control voltage which in turn reduces the gain in the stages 2, 3, and 4. It will be seen that by the use of the special amplifier 14 a separate amplifier for the automatic volume control voltage is not required and the production of that voltage is separate and independent of the production of the audio frequency.

In that form of my invention which I have illustrated by Fig. 2 I employ a special form of amplifier tube 14' which is similar to the tube 14 of Fig. 1 but which includes in addition the gain control grid 40 which, as shown in Fig. 4, encloses the auxiliary anode 19. In this form of my invention I have shown the tuned circuit 31 which is in the auxiliary anode supply circuit coupled to the tuned circuit 41. The transformer windings by which these two circuits are thus coupled are arranged for a close or over coupling. One side of the tuned circuit 41 connects with the diode anode 32, the cathode of which is supplied with a suitable source of positive voltage represented by C. The other side of the tuned circuit 41 connects with ground through the resistor 42 which is shunted by the bypass capacitor 43. It also connects through the filter comprising the resistor 44 and the capacitor 45 with the gain control grid 40 and with the conductor 46 by which negative automatic volume control voltage is supplied to the previous stages.

Inasmuch as the signal used for the production of automatic volume control voltage has passed through fewer tuned circuits than the signal used for audio frequency, the automatic volume control output is broader than the audio output. This effect as obtained with the apparatus shown in Fig. 1 is still further increased by the apparatus shown in Fig. 2 where I employ a pair of closely or over-coupled circuits 31, 41 in place of the single tuned circuit 31.

The production of the automatic volume control voltage by this arrangement is separate from and independent of the production of the audio frequency as in the form shown in Fig. 1. By reason of the addition of the gain control grid 40 to the amplifier the effect of the automatic volume control voltage is added to the output of the main anode 20 whereby the voltage applied to the audio frequency is more nearly uniform when variations occur in the strength of the received signal. By a proper construction of the gain control grid 40 the output of the main anode circuit may be so regulated that beyond a critical strength of signal input the audio frequency voltage will remain substantially constant. This may be accomplished by making the grid of the variable mu type which is known to the art.

I have chosen the particular embodiments described above as illustrative of my invention and it will be apparent that various other modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

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

1. In radio receiving apparatus, the combination of an electron discharge amplifier having a cathode, a control grid, a main anode and an auxiliary anode, means for supplying a signal voltage to said main control grid, means in circuit with said main anode for producing an audio frequency and separate means including a diode detector controlled by the output of said auxiliary anode for producing an automatic volume control voltage.

2. In radio receiving apparatus, the combination of an electron discharge amplifier having a cathode, a control grid, a main anode and an auxiliary anode, all arranged in succession in the same electron stream, said auxiliary anode having an output circuit and the alternating current therein being controlled by said control grid, means for supplying a signal voltage to said control grid, means in circuit with said main anode for producing an audio frequency and means independent of said audio frequency producing means for producing an automatic volume control voltage in response to the alternating current of said auxiliary anode output circuit.

3. In radio receiving apparatus, the combination of an electron discharge amplifier having a cathode, a control grid, a main anode and an auxiliary anode, means for supplying a signal voltage to said main control grid, means comprising a diode detector having a low impedance load resistor controlled by the output of said main anode for producing an audio frequency and means independent thereof and including a diode detector for producing an automatic volume control voltage controlled by the output of said auxiliary anode.

4. In radio receiving apparatus, the combination of an electron discharge amplifier having a cathode, a control grid, a main anode and an auxiliary anode, means for supplying a signal voltage to said main control grid, means controlled by the output of said main anode for producing an audio frequency, said means comprising a tuned circuit including a winding and a diode detector provided with a low impedance load resistor connected across a fractional part of said winding and separate means controlled by the output of said auxiliary anode for producing an automatic volume control voltage.

5. In a radio receiver, the combination of an electron discharge amplifier having a cathode, a main control grid, an auxiliary anode, a gain control grid and a main anode, all in the same electron stream, means for shielding said main control grid from said auxiliary anode, means for supplying a signal voltage to said main control grid, means controlled by said main anode for producing an audio frequency, means controlled by said auxiliary anode for producing an automatic volume control voltage and means for supplying a part of said voltage to said gain control grid.

6. In a radio receiver, the combination of an electron discharge amplifier having a cathode, a main control grid, an auxiliary anode, a gain control grid and a main anode, all in the same electron stream, means for shielding said main control grid from said auxiliary anode, means for supplying a signal voltage to said main control grid, means controlled by said main anode for

producing an audio frequency, separate means controlled by the output of said auxiliary anode for producing an automatic volume control voltage and means for applying a part of said automatic volume control voltage to said gain control grid.

7. In a radio receiver, the combination of an electron discharge amplifier having a cathode, a main control grid, an auxiliary anode, a gain control grid and a main anode, all in the same electron stream, means for shielding said main control grid, said auxiliary anode, and said main anode each from the other, means for supplying a signal voltage to said main control grid, means controlled by said main anode for producing an audio frequency, means independent of said audio frequency producing means for producing an automatic volume control voltage in response to the output of said auxiliary anode and means for supplying said automatic volume control voltage to said gain control grid.

8. In a radio receiver, the combination of an electron discharge amplifier having a cathode, a main control grid, an auxiliary anode, a gain control grid and a main anode, means for supplying a signal voltage to said main control grid, means responsive to the output of said main anode for producing an audio frequency, said means including a coupling transformer, a diode detector provided with a low impedance load resistor connected between one end of a winding of said transformer and an intermediate tap thereof and means independent of the output of said main anode for producing an automatic volume control voltage in response to the output of said auxiliary anode and means for supplying said automatic volume control voltage to said gain control grid, whereby the impedance of said resistor and that part of said winding which supplies the detector are matched and whereby a more uniform output of the audio frequency is obtained with variations in the applied signal voltage.

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