July 14, 1942. H. BOUCKE 2,289,822

AUTOMATIC AUDIO BAND CONTROL

Filed May 24, 1941 2 Sheets-Sheet 1

Fig. 1.

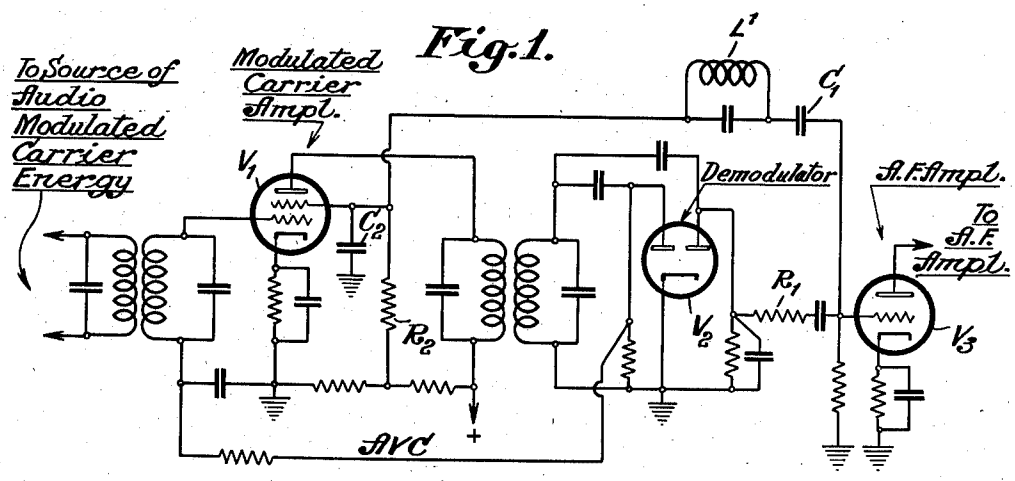
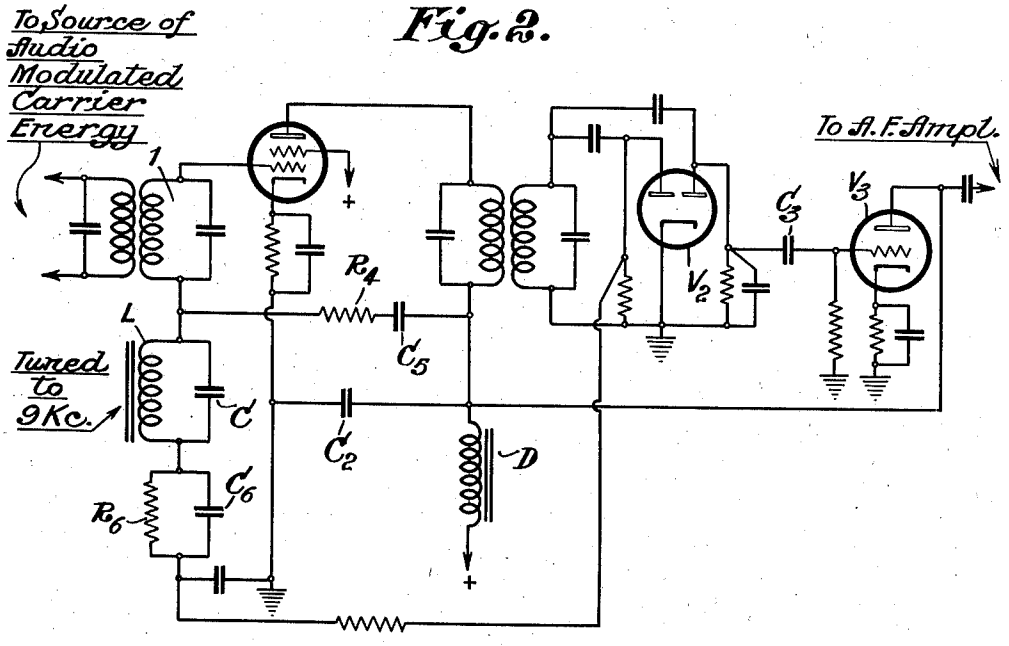


Fig. 2.



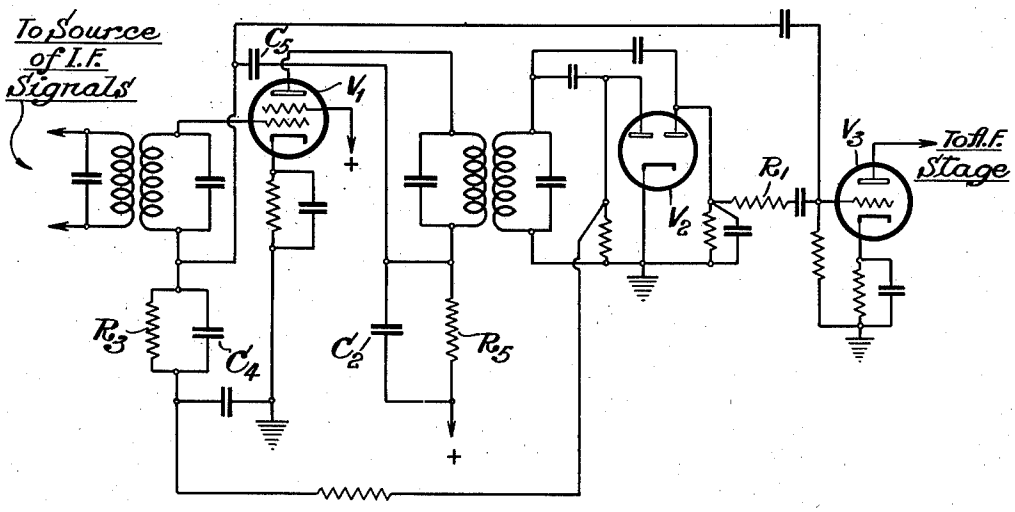
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Fig. 3.



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Patented July 14, 1942

2,289,822

UNITED STATES PATENT OFFICE

2,289,822

AUTOMATIC AUDIO BAND CONTROL

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Application May 24, 1941, Serial No. 394,992
In Germany February 24, 1940

9 Claims. (Cl. 250—20)

It is known in the prior art to control a regulable shunt, by means of the volume control potential, for the high audio frequencies in receivers in such a manner that upon reception of a weak transmitting station the said high audio frequencies are suppressed to a greater extent with the result that the interfering frequencies situated in the range of high audio frequencies are transmitted to a smaller degree. Control of the shunt may be insured, for instance, by the aid of a tube connected so as to act as a regulable resistance. Now, the present invention makes conditions so that an additional tube of this type may be dispensed with, while yet the same effect results.

The object of the present invention consists in employing in a receiver a volume controlled radio frequency or audio frequency tube also, in part or entirely, as a variable audio shunt, particularly by using measures known in reflex circuit organizations.

The invention shall be explained by reference to Figs. 1, 2 and 3 which show three circuit modifications.

Fig. 1 shows the carrier amplifier stage including tube V_1 (which may be at radio or intermediate frequency) preceding the demodulator V_2 as well as the audio stage comprising tube V_3. Tube V_1 is controlled by the volume control potential formed in a manner known in the art. The usual automatic volume control circuit is denoted by the letters "A. V. C." The internal resistance of the screen grid circuit of tube V_1, coupled by way of condenser C_1, serves as the audio frequency shunt. In parallel relationship thereto (for A. C.) is resistance R_2. For a small control potential (A. V. C.) the internal resistance of the screen grid to cathode path is several tens of kilo-ohms, and for maximum control potential it amounts to several hundreds of kilo-ohms or more. Condenser C_1 is chosen so small that together with the internal resistance of the screen grid path it represents a shunt mainly only for the high audio frequencies. What is also important is the fact that the series resistance R_2 of the screen grid has a rather high value, for instance about 150 kilo-ohms. Thus, the circuit is particularly adapted to the use of a tube having a "sliding" screen grid potential.

Two further embodiments result by employing the phenomenon that the internal resistance of the output circuit as well as that of the input circuit in a tube operating with negative potential feedback decreases as the gain of the tube is increased. To this end the radio tube is connected with audio circuit elements besides the radio circuit elements, while an audio reverse feedback path is established.

Fig. 2 shows a circuit adapted to regulate or control the audio band width in which a controlled tube, connected in shunt relation in the audio stage with the aid of a potentiometer for the plate A. C. potential comprising a parallel resonance circuit, acts like a series resonance circuit with variable attenuation, a negative or reverse feedback potential being taken from the said potentiometer for the grid. The grid circuit of the tube V_1 in Fig. 2 thus contains a resonance circuit LC in series with the input circuit I, the said circuit LC being tuned to 9 kilocycles. The said circuit I may be considered the intermediate frequency (I. F.). The I. F. oscillations arising in the plate circuit are fed to the rectifier tube V_2. Condenser C_2 is so chosen that only the I. F. current flows therethrough. The audio potential is fed to the control grid of tube V_3 by way of condenser C_3. As a plate resistance of tube V_3 there is used the choke coil D which should have an impedance as high as possible; that is, an impedance at least equal to the internal resistance of V_3, though preferably larger.

In parallel relation to D is the internal resistance of tube V_1, the internal resistance being frequency-dependent as a result of the negative feedback. The negative fedback potential is fed by way of condenser C_5, to which a high ohmic resistance R_4 may be connected in series, from the end of choke coil D connected with the anode to the end of the 9 kilocycle circuit LC connected with the grid. The result is that C_2—LC forms a frequency-dependent potentiometer for the audio plate potential. In the range in which the frequencies are not negatively fed back, that is in the low and medium, the internal resistance of tube V_1 is very high compared to the impedance of D. On the other hand, in the 9 kilocycle range an apparent decrease of the internal resistance arises. This phenomenon is so much more noticeable the greater the gain of tube V_1 is. As a result, the frequencies in the 9 kilocycle region are attenuated, and this all the more so the greater the gain of tube V_1.

In the third exemplified embodiment, shown in Fig. 3, use is made of the fact that the input resistance of a potential-dependent tube operating with negative feedback between plate and grid, that is the resistance between control grid and cathode, is a function of the degree of negative feedback and thus, for a fixed negative feedback path, of the gain of the tube. As audio grid

resistance of the I. F. amplifier tube V_1 there is used resistance R_3 whose parallel capacity C_4 conducts the radio oscillations to ground. The audio potentials arising across the audio plate circuit resistance R_5 comprising the radio leak (shunt) C_2 are fed by way of condenser C_5 (to which, similarly as in Fig. 2, a high ohmic resistance may be connected in series) to the grid circuit so as to act like a negative feedback potential.

C_5 is expediently chosen so small that the negative feedback practically affects only the high audio frequencies. Upon variation of the gain by means of the volume control potential the value of the effective input resistance of tube V_1 between the terminals of resistance R_3 is altered to a high degree. For a negative feedback, for instance, in which the audio negative feedback potential is ten times that of the audio control potential arising between grid and cathode, R_3 apparently decreases to one-tenth its nominal or rated value. The suppression of the high audio frequencies which thus results is still more effective because of the fact that, besides condenser C_5, condenser C_1 is also so chosen that the low and median audio frequencies are not affected by the action of the shunt.

It is possible, also, to establish the reverse feedback paths in a manner differing from that described in Figs. 2 and 3. What is only important for the object of the invention is that the controlled tube together with the lead by way of C_1 represents an effective frequency-dependent shunt.

In these circuits it is also possible partially to suppress or attenuate the low audio notes simultaneously with the suppression of the high audios in order that reproduction may not sound too hollow. In Fig. 1, for instance, this may be done by connecting in parallel relationship to condenser C_1 an inductance L' which has a low resistance for the low audio frequencies. Condenser C_7 then serves for D. C. decoupling. In a similar manner in Fig. 2 the RC mesh (R_6—C_6) causes an attenuation of the low audio frequencies provided that capacity C_3 is made of sufficient value for all frequencies.

What is claimed is:

1. In combination with an audio amplifier circuit having input and output terminals, a source of audio modulated carrier waves, at least one tube having input and output electrodes, said source being coupled to said input electrodes, means, coupled to the output electrodes, for deriving the audio modulation voltage from waves transmitted through said tube, means applying the derived voltage to said audio input terminals, an audio tone control path in shunt across at least one of said audio circuit terminals, said path including as an element thereof the internal resistance between a pair of electrodes of said tube, and means for controlling the gain of said tube thereby to vary the magnitude of said resistance.

2. In combination with an audio amplifier circuit having input and output terminals, a source of audio modulated carrier waves, at least one tube having input and output electrodes, said source being coupled to said input electrodes, means, coupled to the output electrodes, for deriving the audio modulation voltage from waves transmitted through said tube, means applying the derived voltage to said audio input terminals, an audio tone control path in shunt across at least one of said audio circuit terminals, said path including as an element thereof the internal resistance between a pair of electrodes of said tube, means for providing negative feedback between the output and input electrodes of said tube, and means for controlling the gain of said tube thereby to vary the magnitude of said resistance.

3. In combination with an audio amplifier circuit having input and output terminals, a source of audio modulated carrier waves, at least one tube having input and output electrodes, said source being coupled to said input electrodes, means, coupled to the output electrodes, for deriving the audio modulation voltage from waves transmitted through said tube, means applying the derived voltage to said audio input terminals, an audio tone control path in shunt across at least one of said audio circuit terminals, said path including as an element thereof the internal resistance between a pair of electrodes of said tube, and means for controlling the gain of said tube thereby to vary the magnitude of said resistance, a resonant network, tuned to substantially 9 kilocycles, connected between the said input electrodes, and said internal resistance being that between the output electrodes of said tube.

4. In combination with an audio amplifier circuit having input and output terminals, a source of audio modulated carrier waves, at least one tube having input and output electrodes, said source being coupled to said input electrodes, means, coupled to the output electrodes, for deriving the audio modulation voltage from waves transmitted through said tube, means applying the derived voltage to said audio input terminals, an audio tone control path in shunt across at least one of said audio circuit terminals, said path including as an element thereof the internal resistance between a pair of electrodes of said tube, and means for controlling the gain of said tube thereby to vary the magnitude of said resistance, said internal resistance being that between the input electrodes of said tube, and said gain control means being responsive to variations in carrier amplitude.

5. In combination with an audio amplifier circuit having input and output terminals, a source of audio modulated carrier waves, at least one tube having input and output electrodes, said source being coupled to said input electrodes, means, coupled to the output electrodes, for deriving the audio modulation voltage from waves transmitted through said tube, means applying the derived voltage to said audio input terminals, an audio tone control path in shunt across at least one of said audio circuit terminals, said path including as an element thereof the internal resistance between a pair of electrodes of said tube, and means for controlling the gain of said tube thereby to vary the magnitude of said resistance, said tube including a screen grid electrode, said internal resistance being that between the screen grid and cathode of said tube.

6. In combination with an audio amplifier circuit having input and output terminals, a source of audio modulated carrier waves, at least one tube having input and output electrodes, said source being coupled to said input electrodes, means, coupled to the output electrodes, for deriving the audio modulation voltage from waves transmitted through said tube, means applying the derived voltage to said audio input terminals, an audio tone control path in shunt across at least one of said audio circuit terminals, said path including as an element thereof the internal

resistance between a pair of electrodes of said tube, and means for controlling the gain of said tube thereby to vary the magnitude of said resistance, and means in circuit with said internal resistance for attenuating the low audio frequencies.

7. In a radio receiver of the type having a radio frequency transmission tube provided with at least a cathode, a signal input electrode and an output electrode, a demodulator, an audio amplifier tube, a network for attenuating the higher audio frequencies connected to said audio tube; the improvement which comprises said network including as a control element therefor the internal resistance between said cathode and at least one of the other electrodes of said radio transmission tube, and means, responsive to signal amplitude variation, for automatically controlling the gain of said transmission tube and thereby the magnitude of said resistance.

8. In a radio receiver of the type having a radio frequency transmission tube provided with at least a cathode, a signal input electrode and an output electrode, a demodulator, an audio amplifier tube, a network for attenuating the higher audio frequencies connected to said audio tube; the improvement which comprises said network including as a control element therefor the internal resistance between said cathode and the output electrode of said radio transmission tube, and means, responsive to signal amplitude variation, for automatically controlling the gain of said transmission tube and thereby the magnitude of said resistance.

9. In a radio receiver of the type having a radio frequency transmission tube provided with at least a cathode, a signal input electrode and an output electrode, a demodulator, an audio amplifier tube, a network for attenuating the higher audio frequencies connected to said audio tube; the improvement which comprises said network including as a control element therefor the internal resistance between said cathode and the output electrode of said radio transmission tube, and means, responsive to signal amplitude variation, for automatically controlling the gain of said transmission tube and thereby the magnitude of said resistance, and means providing degenerative signal feedback from the output electrode to said input electrode.

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