Oct. 17, 1933. G. GULLNER ET AL 1,931,070

AUTOMATIC VOLUME REGULATION

Filed Sept. 17, 1930

Fig. 1

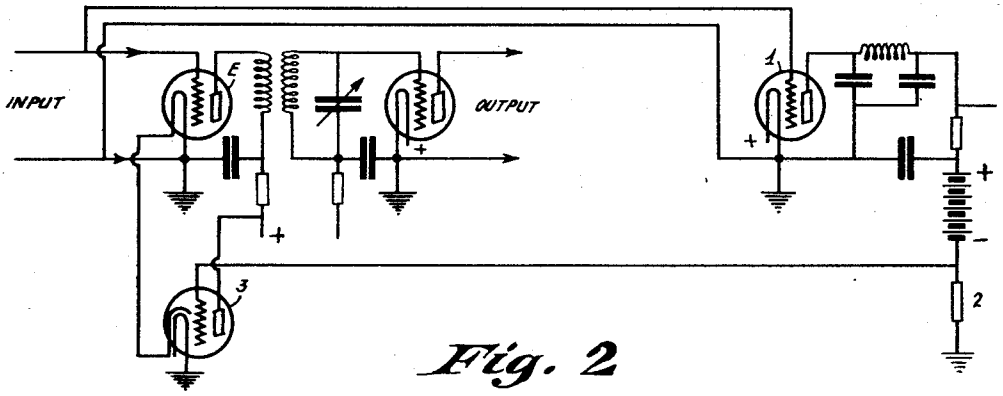



Fig. 2

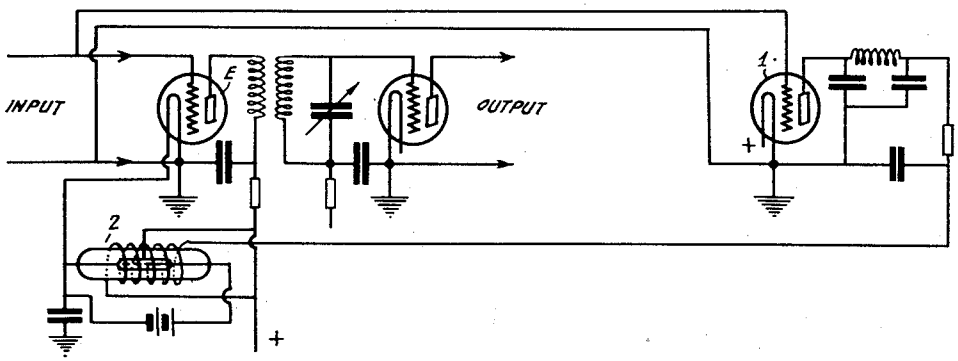
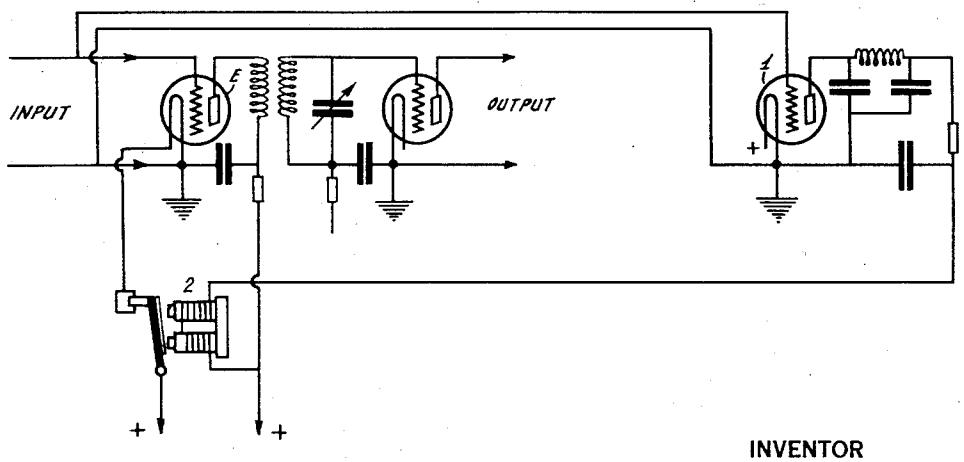



Fig. 3

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## AUTOMATIC VOLUME REGULATION

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17 Claims. (Cl. 179—171)

The present invention relates to amplifier gain control, and more particularly to automatic gain control.

For automatic signal strength, or volume, regulation (fading regulation or compensation) in receiver equipment, it is customary to use the following arrangement: The incoming radio frequency energy is rectified in a rectifier and flows through a resistance, the drop of potential across the latter serving as a biasing potential for any desired tubes of the receiver apparatus. For larger rectifiers, i. e., larger input amplitude, high grid biasing potentials are then obtained, in other words, lower amplification and vice versa, greater amplification in the presence of lower amplitudes. The chief drawback of this arrangement consists in that the amplification of a tube, in the presence of small amplitudes, is capable of being varied only at the ratio of 1:10 lest inacceptably great distortion occur; for, a variation of the amplification of the grid biasing potential is feasible only by working upon the curved part of the characteristic where different slopes can be obtained by shifting the working point. If a plurality of tubes are used simultaneously, the feasible amplification is not raised to a higher power; on the contrary, since in the second or third tube higher amplitudes are present, it is possible to reduce the amplification for two tubes about 30 fold, and for three tubes about 100 fold without distortions being occasioned.

Quite apart from distortion, in volume regulation by variation of the grid polarizing potential, conditions are also dependent upon the quality of neutralization. But this latter condition is not true wherever receiver equipment working with an intermediate frequency is dealt with, and if the grid biasing potential of the frequency changer tube is regulated, but, then in turn, the amount of regulation is too small.

To obviate these drawbacks an automatic volume regulating scheme is disclosed in the present invention which is based upon the regulation of the heating of the cathode of the controlled tube. It is known in the prior art that by heating control the amplification of any tube is variable inside wide limits without an incidental distortion. The underlying reason is that the slope of the tube decreases, while the characteristic remains straight. Circuit schemes according to this invention are described in what follows.

The novel features which we believe to be characteristic of our 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 we have indicated diagrammatically several circuit organizations whereby our invention may be carried into effect.

In the drawing,

Fig. 1 shows a circuit embodying the invention,

Figs. 2 and 3 show modified forms of the invention.

Part of the incoming energy is supplied to the grid of the rectifier 1 (Fig. 1), and the direct current flowing therethrough produces across the terminals of a resistance 2 a fall of potential which is utilized to vary the biasing potential of a tube 3 for which most suitably an indirectly heated tube is employed. The emission current of tube 3 is used as the filament heating current of a tube E of the receiver. Where large incoming amplitudes are concerned, in other words, where the direct current flowing through tube 1 is large, there is set up a higher negative grid biasing potential in tube 3, and this results in a lower filament heating current for tube E. As a result the amplification of the receiver tube E is diminished. The most essential advantage of this arrangement above all resides in that the amplification of a tube may be reduced at the ratio 1:1000 without distortions being incidentally caused. On the other hand in a receiver outfit working with an intermediate frequency the heating tube may be changed, and this independently of the quality of neutralization.

Other schemes of automatic fading regulation by change of filament heating are as follows:

In lieu of the normal hot cathode tube 3, a magnetron as shown in Fig. 2 is employed through the magnetizing coil of which the direct current coming from the rectifier 1 is flowing. In the presence of fluctuations the emission current of the magnetron, and thus the heating of a tube E of the amplifier arrangement is altered. In the presence of relatively large direct current a larger magnetic field is obtained, and the emission current of the magnetron, and thus the amplification of the receiver decreases. Whenever the rectifier current is smaller, conditions are reversed. This arrangement offers the advantage that no distinct plate battery and no resistance are required. Another advantage is that the great slope of the magnetron affords good regulation.

According to Fig. 3 the direct current of the

rectifier flows by way of a relay 2 which, when the currents are heavy, cuts resistance in the heating circuit of the tube to be regulated; while when the currents are small, resistance is cut out of the circuit.

While we have indicated and described several systems for carrying our invention into effect, it will be apparent to one skilled in the art that our 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 our invention as set forth in the appended claims.

What we claim is:

1. In combination, a high frequency amplifier tube including a cathode and a heating source therefor, a rectifier having its input connected with the input circuit of said amplifier tube, and means connected to the rectifier output and heating source to vary the cathode heating to control the amplifier gain.

2. The method of varying the amplification of a vacuum tube amplifier which consists in producing a current whose amplitude is proportional to the envelope of the alternating input energy applied to the tube and in controlling the electron emissivity of the cathode of the tube in accordance with the amplitude of the current so produced.

3. The method of controlling the amplification of a vacuum tube amplifier which consists in rectifying a portion of the input energy and utilizing the direct current component of the rectified energy to determine the emissivity of the tube cathode.

4. The method of operating a translating circuit, including a three-element vacuum tube, which consists in producing a current whose amplitude is proportional to the envelope of the alternating input energy applied to the tube and in so controlling the cathode emissivity of the vacuum tube in accordance with the amplitude of the current so produced that a predetermined relation between the input energy applied to the system and the output energy from the system will be obtained.

5. The method of operating a translating circuit, including a three-element, vacuum tube which consists in producing a current whose amplitude is proportional to the envelope of the alternating input energy applied to the tube and in so controlling the cathode emissivity of the tube in accordance with the amplitude of the current so produced that the output energy will be a maximum for a predetermined amplitude of the input energy.

6. The method of operating a translating circuit, including a three-element vacuum tube, which consists in applying input energy to the tube, rectifying a portion of the input energy before it is applied to the tube, and so controlling the cathode emissivity of the tube by means of the direct current component of the rectified energy that a predetermined ratio between the input energy applied to the system and the output energy transmitted from the system will be obtained.

7. The method of operating a vacuum tube amplifier which consists in producing a current whose amplitude is proportional to the envelope of the alternating input energy applied to the tube and in adjusting the cathode energization in accordance with the amplitude of the current so produced.

8. In a translating system, a three-element vacuum tube, means to apply energy variations to said tube, means to produce a current whose amplitude is proportional to the envelope of the alternating energy so applied, and means to adjust the cathode energization of said tube in accordance with the amplitude of the current so produced.

9. In a translating system, a vacuum tube amplifier, means to apply alternating currents to the grid circuit of said tube, means controlled by said alternating current for producing a direct current potential whose value is determined by the amplitude of said alternating current, and means to apply said direct current potential to said vacuum tube to control its cathode emissivity.

10. In a translating system, a vacuum tube amplifier, means to apply alternating current to the input circuit of said amplifier, a vacuum tube rectifier, means to apply said alternating current to said vacuum tube rectifier, thereby producing rectified direct current, and means to control the emissivity of the cathode of said vacuum tube amplifier in accordance with the amplitude of said rectified direct current.

11. In a translating system, a vacuum tube amplifier, means to apply alternating current to the input circuit of said amplifier, a vacuum tube rectifier including an impedance in its output circuit, means to apply said alternating current to said vacuum tube rectifier, thereby producing rectified direct current, and means to control the emissivity of the cathode of said vacuum tube amplifier in accordance with the amplitude of said rectified direct current.

12. In a translating system, a vacuum tube amplifier, means to apply alternating current to the input circuit of said amplifier, a vacuum tube rectifier, means to apply said alternating current to said vacuum tube rectifier, thereby producing rectified direct current, and means including an electron discharge tube to control the emissivity of the cathode of said vacuum tube amplifier in accordance with the amplitude of said rectified direct current.

13. In a translating system, a vacuum tube amplifier, means to apply alternating current to the input circuit of said amplifier, a vacuum tube rectifier, means to apply said alternating current to said vacuum tube rectifier, thereby producing rectified direct current, and means including a magnetron tube to control the emissivity of the cathode of said vacuum tube amplifier in accordance with the amplitude of said rectified direct current.

14. In a translating system, a vacuum tube amplifier, means to apply alternating current to the input circuit of said amplifier, a vacuum tube rectifier, means to apply said alternating current to said vacuum tube rectifier, thereby producing rectified direct current, and means including an electro-magnetic relay device connected with the cathode of said amplifier to control the emissivity of the cathode of said vacuum tube amplifier in accordance with the amplitude of said rectified direct current.

15. The method of operating an electrical wave transmission network including an electron discharge tube which consists in producing a current whose amplitude is proportional to the envelope of alternating input energy applied to the tube, and controlling the intensity of emission of electrons in said tube inversely with the amplitude of the current so produced.

16. In a translating system, a vacuum tube amplifier, means to apply alternating current to

the input circuit of said amplifier, a vacuum tube rectifier, means to apply said alternating current to said vacuum tube rectifier, thereby producing rectified direct current, and means including an electron discharge tube having its grid connected to the rectifier anode circuit and its cathode and anode connected respectively to the cathode and anode circuits of the amplifier to control the emissivity of the cathode of said vacuum tube amplifier in accordance with the amplitude of said rectified direct current.

17. In a translating system, a vacuum tube amplifier, means to apply alternating current to the input circuit of said amplifier, a vacuum tube rectifier, means to apply said alternating current to said vacuum tube rectifier, thereby producing rectified direct current, and means including a magnetron tube having its magnetizing coil connected to the anodes of the rectifier and amplifier, to control the emissivity of the cathode of said vacuum tube amplifier in accordance with the amplitude of said rectified direct current.

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