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AMPLIFIER CONTROL CIRCUITS

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Fig. 1

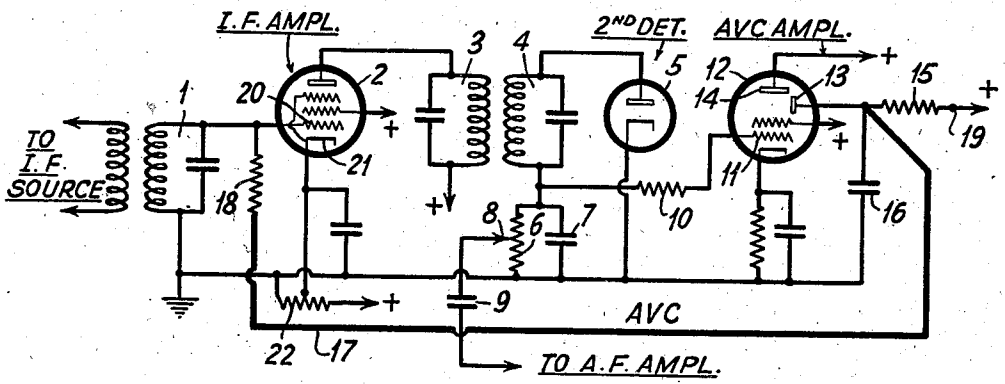


Fig. 2

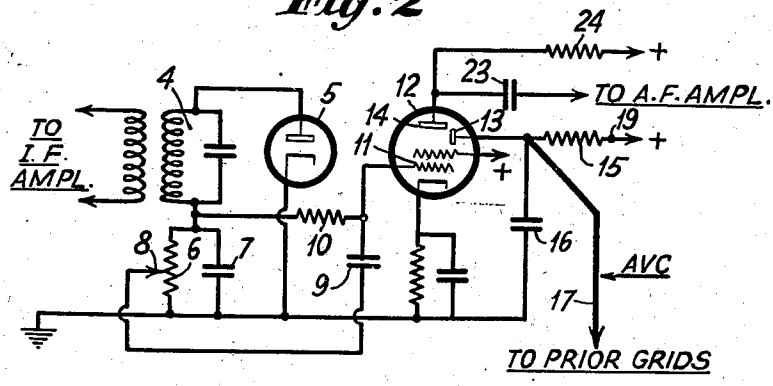
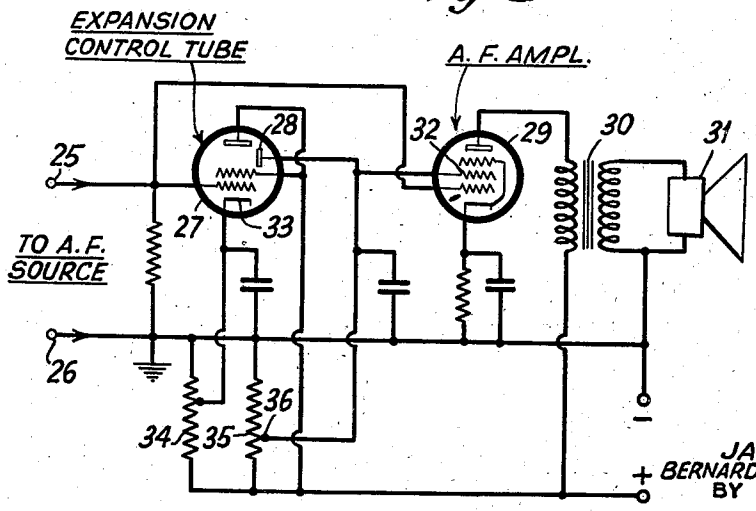


Fig. 3



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AMPLIFIER CONTROL CIRCUITS

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7 Claims. (Cl. 179—171)

This invention relates to a circuit for generating or amplifying a control voltage. Control voltages are used in circuits for amplifying and/or selecting a frequency band. Thus, for example, a control voltage permits of controlling the amplification of a circuit of this character so as to be at least substantially inversely proportioned to the input voltage supplied to the circuit. This is the so-called automatic volume control which is used with radio receivers. In this case the value of the control voltage depends on the intensity of the input voltage which is to be amplified. As an alternative, in a circuit serving for the selective amplification of a frequency band a control voltage may be used for controlling the selectivity of the circuit, for example, in accordance with interfering, adjacent channel voltages. In such a circuit control voltage may also be used for correcting tuning, the value of the control voltage depending on the divergence between the received frequency band and the frequency to which the receiver is tuned.

Both the latter controls are known with wireless receivers as "automatic band width control" and "automatic frequency control." In addition, the control voltage may be used in low frequency amplifier circuits for controlling the gain in accordance with the signal voltages to be amplified, e. g., for obtaining contrast expansion or contrast compression. In the above mentioned circuits the control voltage is generally obtained by rectifying the alternating voltage from which the control voltage has to be derived with the aid of a diode, so that a negative control voltage relative to earth, to which the diode cathode is generally connected, is set up.

In the part of the specification following hereinafter a negative, or positive, control voltage is intended to mean a voltage which is lower or higher respectively than the voltage which is set up when the signal voltage from which the control voltage is derived is equal to zero. Such a negative control voltage can be used directly for automatic volume control, for automatic band-width control, for automatic tuning correction and for contrast compression. For contrast expansion, however, a positive control voltage is required so that the negative control voltage must be supplied to a reversing tube.

For obtaining a more intense control it has been suggested to amplify the control voltage in a direct current amplifier valve. This involves, however, the disadvantage that the control voltage changes its polarity so that either special circuits for the use of a positive control voltage have to be used, or positive control voltage has to be derived which after amplification results in a negative control voltage. This, however, entails the disadvantage that the diode cathode is not connected to earth.

According to the invention the above mentioned difficulties are obviated due to the fact that the circuit comprises a tube having at least one control grid, one auxiliary cathode emitting secondary electrons and one anode, to the control grid of which the control voltage to be amplified, or a voltage from which the control voltage is derived, is supplied and from the auxiliary cathode of which the control voltage generated, or amplified, is obtained.

If a negative control voltage is supplied to the control grid of the said valve an amplified negative control voltage may be obtained from the auxiliary cathode. The use of such a tube offers, therefore, the advantage that during the amplification of the control voltage the polarity is not reversed. By connecting the tube as an anode detector and supplying a low frequency signal voltage to the control grid a positive control voltage for contrast expansion can be obtained at the auxiliary cathode. The advantage of this circuit is that a supplementary tube for reversing the polarity of the control voltage can be economized.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawing, in which

Fig. 1 shows a circuit for automatic volume control with amplified control voltage according to the invention,

Fig. 2 shows a modification wherein the tube for amplifying the control voltage also serves as a low frequency amplifier valve,

Fig. 3 shows a circuit arrangement of a low frequency amplifier with contrast expansion according to the invention.

In Fig. 1 an intermediate frequency (I. F.) amplifier stage and a diode detector of a superheterodyne radio receiver are shown. The intermediate frequency oscillations occurring in an intermediate frequency circuit 1 are amplified by an amplifier valve 2 and supplied to an intermediate frequency circuit 3 which, jointly with an intermediate frequency circuit 4, forms a bandpass filter. The intermediate frequency voltage which occurs across the circuit 4 is rectified by a diode 5, and with the interposition of a resistance 6 shunted by a condenser 7, supplies

a direct control voltage upon which the low frequency oscillations are superposed. The low frequency voltage is supplied to a low frequency amplifier (not shown) by a contact 8 slidable on the resistance 6 and a condenser 9.

The negative control voltage occurring across the resistance 6 is supplied by a resistance 10 to the control grid 11 of a valve 12. The valve 12 comprises an auxiliary cathode 13 which, upon bombardment by electrons, emits secondary electrons which move to an anode 14. The auxiliary cathode 13 receives a positive voltage through a resistance 15, and is connected to earth by a condenser 16 which has a negligible impedance. The auxiliary cathode 13 is connected to the control grid 20 of the amplifier valve 2 through the conductor 17 and resistance 18.

When feeble signals are being received the diode 5 supplies only a small negative direct voltage so that an intense flow of electrons flows in the valve 12 from the cathode to the auxiliary cathode 13. Thus, the auxiliary cathode emits a lot of secondary electrons so that the potential of the auxiliary cathode is higher than the potential of the end 19 connected to the positive terminal of the source of voltage supply (not shown), of the resistance 15. The control grid 20 of the amplifier valve 2 has the same potential as the auxiliary cathode 13, and the cathode 21 of the valve 2 has a slightly higher positive potential relative to earth due to its being connected to a point of a potentiometer 22 connected between earth and the positive terminal of a source of voltage supply.

In the case of feeble signals the valve 2 has a low negative grid voltage and a high amplification. If, on the contrary, powerful signals are being received the control grid 11 of the valve 12 is highly negative. Little current flows to the auxiliary cathode 13 and the potential of the auxiliary cathode 13 is only slightly more positive than the potential of the point 19. Consequently, the potential of the control grid 20 is, also, less positive than with feeble signals so that the valve 2 has but a low amplification. Referring to the drawing, the automatic volume control (AVC) is only effected on the valve 2. The auxiliary cathode 13 may, however, be connected to the control, or regulating, voltage grids of one, or more, preceding valves (not shown) also with the interposition of resistances.

Referring to Fig. 2, in which similar parts are designated by like reference numerals, the valve 12 is also used as a low frequency, or audio, amplifier valve. The control grid 11 has supplied to it the control voltage to be amplified through a resistance 10, and the low frequency alternating voltage to be amplified is fed through the condenser 9. Similarly to Fig. 1 the amplified control voltage is obtained from the auxiliary cathode 13. The amplified low frequency voltage is supplied to the low frequency amplifier (not shown) by a condenser 23. The anode circuit of the valve 12 comprises a resistance 24.

Fig. 3 shows the final stage of a low frequency amplifier employing contrast expansion. The terminals 25 and 26 have supplied to them audio voltage. The terminal 25 is connected to the control grid of a valve 27, which comprises an auxiliary cathode 28, and to the grid of an amplifier valve 29, the anode circuit of which includes the primary of a loudspeaker transformer 30. A loudspeaker 31 is connected to the secondary of the said transformer. The valve 29 contains a screening grid 32. The terminal 26 is earthed.

The low frequency voltage which occurs between the terminals 25 and 26 is amplified by the valve 29 and supplied to the loudspeaker 31. The amplification of the valve 29 depends on the potential of the screening grid 32. This screening grid is connected, jointly with the auxiliary cathode 28 of the valve 27, to a point 36 of a potentiometer 35, and has, therefore, the same potential as this auxiliary cathode. The cathode 33 of the valve 27 is connected to such a point of the potentiometer 34 that the valve 27 is adjusted as an anode detector. The flow of electrons passing from the cathode 33 to the auxiliary cathode 28 is consequently dependent upon the value of the low frequency voltage which occurs between the terminals 25 and 26. In the case of a high voltage much current, and in the case of a low voltage little current, flows to the auxiliary cathode. At high voltage the potential of the auxiliary cathode 28, and thus the potential of the screening grid 32, is high so that the amplification of the valve 29 is also high. In the case of lower audio voltages on the contrary the amplification of the valve 29 decreases. This results in contrast expansion. The advantage of the use of a valve comprising an auxiliary cathode for the generation of the control voltage required for contrast expansion resides in the fact that a diode and a separate reversing tube can be omitted.

What is claimed is:

1. In combination with a signal voltage amplifier tube, means responsive to signal amplitude variation for controlling the gain of the amplifier, said responsive means including a tube having at least an electron emission element, a plate, a control electrode and a secondary electron emission electrode arranged adjacent the path of electrons flowing from said element to said plate, a direct current voltage control connection from the secondary emission electrode to said amplifier, and means for applying signal-representative voltage to said control grid.

2. In combination with a signal voltage amplifier tube, means responsive to signal amplitude variation for controlling the gain of the amplifier, said responsive means including a tube having at least an electron emission element, a plate, a control electrode and a secondary electron emission electrode arranged adjacent the path of electrons flowing from said element to said plate, a direct current voltage control connection from the secondary emission electrode to said amplifier, and means for applying signal-representative voltage to said control grid, said last means including a rectifier of signals applied to said amplifier, and a direct current voltage connection between said rectifier and control grid.

3. In combination with a signal voltage amplifier tube, means responsive to signal amplitude variation for controlling the gain of the amplifier, said responsive means including a tube having at least an electron emission element, a plate, a control electrode and a secondary electron emission electrode arranged adjacent the path of electrons flowing from said element to said plate, a direct current voltage control connection from the secondary emission electrode to said amplifier, and means for applying signal-representative voltage to said control grid, said amplifier being an audio amplifier, a source of audio signal voltage for the amplifier, said ampli-

fier having an auxiliary gain control electrode in addition to input and output electrodes, and said control connection being made to said auxiliary gain control electrode.

4. In combination with a signal voltage amplifier tube, means responsive to signal amplitude variation for controlling the gain of the amplifier, said responsive means including a tube having at least an electron emission element, a plate, a control electrode and a secondary electron emission electrode arranged adjacent the path of electrons flowing from said element to said plate, a direct current voltage control connection from the secondary emission electrode to said amplifier, and means for applying signal-representative voltage to said control grid, said amplifier having signal voltage input and output electrodes, and said control connection being made to an input electrode of said amplifier.

5. In combination with a signal voltage amplifier tube, means responsive to signal amplitude variation for controlling the gain of the amplifier, said responsive means including a tube having at least an electron emission element, a plate, a control electrode and a secondary electron emission electrode arranged adjacent the path of electrons flowing from said element to said plate, a direct current voltage gain control connection from the secondary emission electrode to said amplifier, and means for applying signal-representative voltage to said control grid, a source of modulated carrier signal voltage coupled to the amplifier input electrodes, a detector coupled to said amplifier output electrodes and providing detected signal voltage, said applying means impressing the detected signal voltage upon said control grid and means for deriving amplified detected signal voltage from the plate of said control tube.

6. In a system of the type having a signal source, an amplifier for the signals and means for utilizing amplified signals, the method of automatically controlling the gain of the amplifier which includes generating a stream of primary electrons of a predetermined intensity, producing a stream of secondary electrons with said first stream, deriving a direct current voltage from said secondary electron stream, applying said derived voltage to said amplifier to control the gain thereof, and regulating the intensity of said first stream in response to amplitude variations in said signals.

7. In a system of the type having a signal source and an amplifier for the signals, the method of automatically controlling the gain of the amplifier which includes generating a stream of primary electrons of a predetermined intensity, producing a stream of secondary electrons with said first stream, deriving a gain control voltage from said secondary electron stream, applying said derived voltage to said amplifier to control the gain thereof, regulating the intensity of said said first stream in response to amplitude variations in said signals by rectifying signals amplified by said amplifier and applying the rectified signal voltage to regulate said first stream intensity and deriving amplified rectified signals from said primary electron stream.

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