May 3, 1938. R. HOFER 2,115,854

PUSH-PULL AMPLIFIER

Filed June 15, 1935

Fig. 1

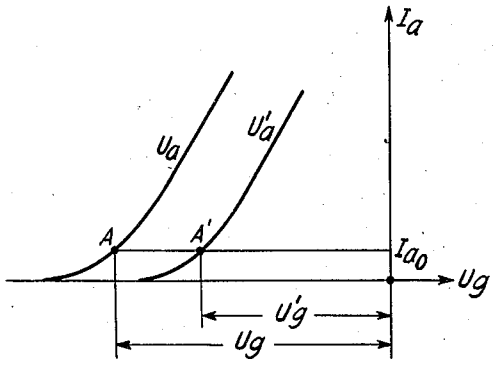
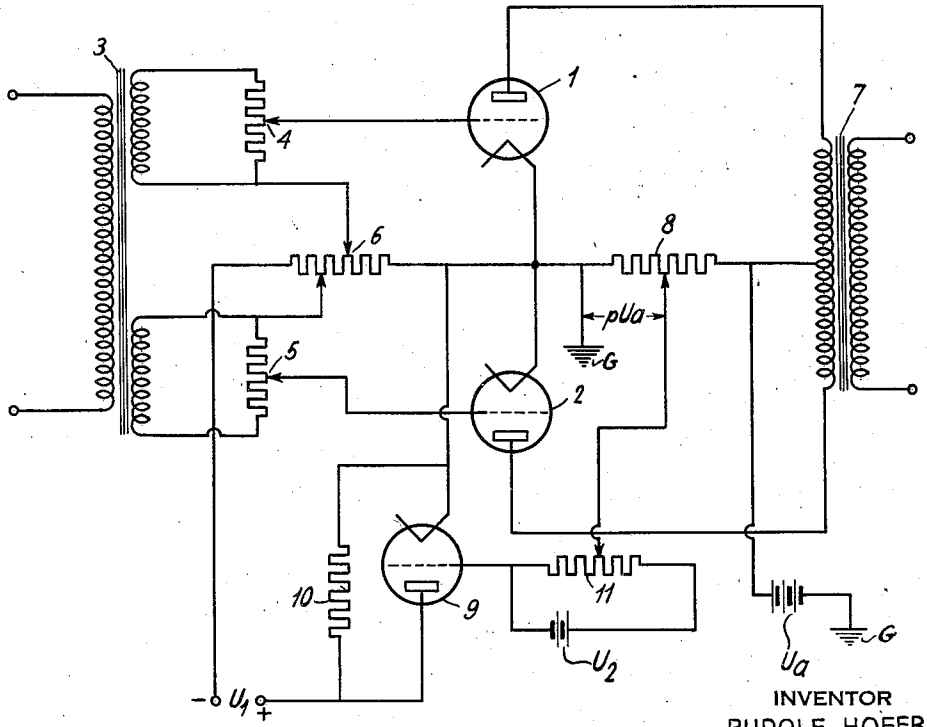


Fig. 2



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PUSH-PULL AMPLIFIER

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3 Claims. (Cl. 179—171)

The present invention relates to amplifiers and more particularly to Class-B amplifiers.

It is an object of the present invention to devise an arrangement through which it is possible to connect an amplifier of the Class-B type to an energizing source which is poorly regulated without introducing excessive distortion. This object is accomplished by that the grid bias applied to the two tubes of the amplifier is varied in accordance with variations in the plate supply.

In the drawing, Figure 1 illustrates a curve sheet which is utilized to describe the invention and Figure 2 illustrates in diagrammatic form a preferred embodiment of the invention.

If amplifiers, especially those used for voice and music and thus being subject to a constantly changing modulation percentage, are to be operated under conditions insuring satisfactory efficiency, or if a higher output or useful power is to be obtained from a given kind of tubes, they are run in what is called a B-type push-pull amplifier circuit arrangement. In order to minimize distortions, the grid biasing voltage should be so adjusted that the working point A comes to lie at a definite point on the lower knee of the tube characteristic. To this working point, as shown in Fig. 1, in the presence of a definite plate D. C. voltage U_a, there corresponds a certain plate current I_{ao} and a definite grid biasing potential U_g.

If during operations the plate D. C. voltage U_a experiences an alteration, then the working point must likewise be changed and shifted to prevent an increase in distortion. If the change $U'_a - U_a$ of the plate D. C. voltage is not very great, it will be possible to assume with practically sufficiently close accuracy that at plate potential U'_a, the working point A' (being optimum for B-operation) will lie around the same plate (feed or static) current I_{ao}. However, to this working point A' there corresponds another grid biasing voltage U'_g. Hence, in order that, in spite of fluctuations of the plate D. C. voltage, the working point which will be adapted to B-operation may be obtained, it is necessary that the grid biasing voltage should be regulated in dependence upon the plate D. C. voltage.

This problem, according to this invention, is solved in such a way that a potential proportional to the plate D. C. voltage is brought to act upon a D. C. amplifier which influences the grid biasing voltage of the push-pull B-type amplifier in accordance with the plate D. C. voltage.

One exemplified embodiment of the basic idea of this invention is illustrated fundamentally in Fig. 2.

Referring to Fig. 2, 1 and 2 denote the tubes comprised in a B-type push-pull amplifier which work upon an output transformer 7. The alternating voltage to be amplified is fed to an input transformer 3 which works upon two resistances 5 and 4. By conveniently shifting of the slides along the said resistances 4 and 5, discrepancies in the mutual conductance of tubes 1 and 2 may be equalized so that each tube furnishes the same alternating voltage to the corresponding half of the winding of the transformer 7. U_1 designates a constant D. C. voltage source which drives a current across the resistances 6 and 10 and the amplifier tube 9 connected in parallel relation to resistance 10. Across the resistance 6 is tapped the particular grid biasing voltage U_g which is required for each of the tubes 1, 2, in B-operation for a given plate voltage U_a.

Tube 9 insures the regulation of the grid biasing voltage U_g as a function of the plate voltage U_a. For this purpose there is tapped on the voltage divider 8 a suitable part pU_a of the plate voltage. From a constant source of auxiliary voltage U2 there is derived a suitable voltage by the aid of the voltage divider 11, the said voltage being connected in opposition to the voltage pU_a and which has such a value that the difference between the two potentials will impart to the tube 9 a definite negative grid biasing potential. If the plate D. C. voltage U_a grows, then, as a result of a proportional growth of the voltage pU_a the tube 9 will be impressed with a less negative bias, with the result that its D. C. resistance decreases, and thus also the resistance of the entire circuit 6, 9, 10. The constant voltage source U1 therefore furnishes a larger current which creates across 6 a higher fall of potential and thus also a grid biasing voltage tapped on 6 and which is raised negatively in accordance with the increased plate voltage U_a. A similar action occurs when the plate voltage U_a decreases.

The regulating device, fundamentally speaking, may be operated also without the resistance 10 working in parallel to tube 9.

I claim:

1. In a relay circuit, a thermionic tube having an anode, a cathode and a grid electrode, a source of direct current, an impedance element connected across said source, an anode circuit for said tube including said impedance element, said source of direct current being arranged with respect to said impedance element so so that the anode is maintained at a positive potential with

respect to the cathode of the tube, a variable impedance device for controlling the bias potential applied to the control electrode, said variable impedance device comprising a space path of a thermionic tube, said last named tube being provided with an anode, a cathode and a control electrode, means for applying a potential to the last named control electrode which varies in accordance with the flow of current in said impedance element, comprising a connection between the last named control electrode and a point of the impedance element, said last named connection including a source of electrical potential which is arranged so as to impress upon the last named control electrode, a fixed potential of opposite polarity to the potential applied through said connection to the impedance element whereby the negative potential applied to the last named controlled electrode is the difference between said two potentials.

2. In a relay circuit, a thermionic tube having an anode, a cathode and a control electrode, a circuit connecting the control electrode and the cathode and including a resistance element, a circuit connected between the anode and cathode of said device and including a source of space current connected in the last named circuit so as to maintain the anode at a positive potential with respect to the cathode of said tube, a second thermionic tube having an anode, a cathode and a control electrode, means connecting the two cathodes, a connection between the anode of the second tube and the control electrode of the first tube, including a source of direct potential arranged so that the positive terminal thereof is connected to the anode of the second tube and the negative terminal thereof to the control electrode of the first tube, a resistor shunted across the source of space current, an auxiliary source of direct potential having a negative and a positive terminal, means connecting the control electrode of the second tube to the negative terminal of the last named source, a resistor shunted across the last named source, and means connecting a point of the last named resistor to a point of the resistor which shunts the source of space current.

3. In a relay circuit, a thermionic tube including an anode, a cathode and a grid electrode, a grid electrode to cathode circuit including a resistor element, an anode to cathode circuit including a source of space current for the tube, a second electronic tube having an anode, a cathode and a control electrode, means for connecting the cathode of the second tube to the cathode of the first tube, an anode to cathode circuit for said second tube including a source of space current and said first named resistor in series, a control electrode to cathode circuit for the second tube including a direct current source of potential connected with its negative terminal nearest the control electrode of the second tube and at least a portion of said source of space current in series, whereby the potential applied to the control electrode of the second tube with respect to the cathode thereof is the difference between the potentials of said two series sources.

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