CIRCUIT ARRANGEMENT FOR STABILIZING THE OPERATING POINT OF AN AMPLIFIER TUBE

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The invention relates to a circuit arrangement for stabilizing the operating point of an amplifier which is supplied from a supply source having a considerable internal resistance, to which source a strongly varying load is connected. If the load is varied, in general also the direct current and voltages of the electrodes of the amplifier vary, so that the operating point is shifted. As a result of this, the properties of the tube also vary, in particular its transconductance, so that its satisfactory functioning may be uncertain.

It is known per se that this drawback may be avoided by stabilizing the supply voltage, for example by use of a gas discharge stabilizer tube. However, this expedient requires a higher investment and also a higher load on the supply source.

In a circuit arrangement of the above type, a true stabilization of the operating point can be obtained with substantially smaller investment if, according to the invention, between the load B and the supply source, a resistor R is connected and the control electrode of the amplifier is connected to the junction point of the load and the resistor, in which the relationship R = R1 is satisfied, wherein R is the value of the resistor, D is the "Durchgriff" coefficient of the amplifier and R1 is the internal resistance of the supply source. The term "Durchgriff" is the inverse of the voltage amplification factor of tube T.

In this manner, the anode current flowing through the amplifier tube T is kept constant, the influence of a variation of the anode voltage is compensated by a corresponding control at the grid. As a result of this, at least the transconductance is very accurately stabilized.

In order that the invention may readily be carried into effect, one embodiment thereof will now be described more fully, by way of example, with reference to the accompanying drawing.

The figure shows the direct-current operation of an amplifier tube T as essential for explanation of the present invention. The signal source and the input and output terminals for oscillations or measuring quantities of the like to be amplified are not shown, since these may be provided in the normal manner.

The figure shows a circuit arrangement which is supplied by a source of direct current, the E.M.F. of which has the value U0. However, the source has an internal resistance R0, so that the operating voltage U0 actually available is smaller due to the voltage drop across the resistor R0. This voltage drop varies with the load. The load is indicated as a variable resistor B and may be formed, for example, by one or several amplifier tubes which are controlled so that their current varies considerably.

An amplifier tube T is connected to the supply source, in the anode branch of which an operating resistor R4 is connected and in the cathode branch of which a resistor R5 is connected. If the grid of this tube T is connected to a potentiometer supplied by the operating voltage U0, the bias voltages of the tube vary if the operating voltage varies, in particular the anode voltage and the cathode voltage U0, so that the anode current and cathode current of the tube also fluctuate.

In order to avoid this, according to the invention, a resistor R is connected between the load resistor B and the negative terminal of the supply source. Resistor R is proportioned so that the relationship R = R0 is satisfied. The control grid of the tube T is connected to the junction point of the load B and of the resistor R. If the load resistor B becomes smaller and consequently the load for the supply source increases, the voltage division at the resistors B and R is shifted so that the voltage at the grid of the tube T becomes more positive.

As a result of this, the influence of the decreasing anode voltage is compensated and the cathode current stabilized. As may be seen, a possibly desired overcompensation may be reached by increasing the resistance R.

The invention is of particular importance for smaller devices which are provided only with a comparatively weak supply source, for example a rectifier circuit connected to an A.C. supply source. This is the case, for example, with converters as they are used in television receivers, to convert receiving signals of a higher frequency range to lower frequencies. Such devices often have only two tubes, one of which, connected as an oscillator, receives its bias voltage from the oscillator oscillations, the amplitude of which strongly depends upon the frequency adjusted. In a corresponding manner, consequently also the load produced by this oscillator tube varies, which would effect the other tube serving preferably as pre-amplifier. A variation of the operating point of the pre-amplifier tube, however, produces a variation of its amplification and possibly also a deterioration of its noise properties. By using the invention, a complete stabilization of the operating point of the pre-amplifier tube can be obtained. If this tube operates in common grid arrangement, the grid may be connected to earth, as indicated in the figure in dotted lines. Similar relations are obtained also in a receiving or amplifier apparatus having a final stage connected for class B operation.

As may be seen, the invention may also be used if a different electron tube is used, for example a multiple grid tube such as a pentode, in which, if desired, a particular correction of the resistance R is required so as to take into account the influence of additional electrode bias voltages on the anode current and cathode current respectively.

Also in the case of a circuit arrangement with transistors, substantially the same relations present themselves, so that in this case also, the invention may be used mutatis mutandis.

Since the anode-cathode current of the tube T is stabilized in the circuit arrangement according to the invention, the cathode resistor R4 and the anode resistor R5 may have voluntary values, as may be required on the basis of the destination of the circuit arrangement. As a result of the voltage drop at the resistor R, an additional grid bias voltage U2 is obtained anyhow, which has to be taken into account when proportioning the cathode resistor R4 for establishing the operating point.

What is claimed is:

1. A circuit comprising an amplifier device of the type having first and second electrodes between which the main amplifier device current flows and a third electrode for controlling the flow of current between said first and second electrodes, a source of operating current including internal resistance, means connecting said source between said first and second electrodes, a variable load circuit connected to said source, and means for maintaining the current flow between said first and second electrodes substantially constant with variations of the voltage of said source due to variations in the current in said load circuit flowing through the internal resistance of said source, said means comprising a resistor connected...
in series between said source and said load circuit, and means connecting the junction of said resistor and load circuit to said third electrode, said resistor having a value \( R \) determined by the expression:

\[
R = DR_1
\]

where \( D \) is the inverse of the voltage amplification factor of said device, and \( R_1 \) is the internal resistance of said source.

2. A circuit comprising an amplifier device of the type having an output electrode, a common electrode, and a control electrode for controlling the current flow between said common and output electrodes, a source of operating voltage exhibiting internal resistance and having first and second terminals, output circuit means connected between said output electrode and said first terminal, means connecting said common electrode to said second terminal, a variable load circuit, means connecting said load circuit between said first and second terminals, and stabilizing means for maintaining the common electrode-output electrode current flow of said device substantially constant with variations of the voltage of said source due to variations in the current of said load circuit flowing through the internal resistance of said source, said stabilizing means comprising a resistor connected in series between said load circuit and said second terminal, and means connecting the junction of said resistor and load circuit to said control electrode, said resistor having a value \( R \) determined by the expression:

\[
R = DR_1
\]

where \( D \) is the inverse of the voltage amplification factor of said device, and \( R_1 \) is the internal resistance of said source.

3. A circuit comprising an electron discharge device having cathode, control grid, and anode electrodes, a source of operating voltage having internal resistance, means connecting said source between said anode and cathode electrodes, a variable load circuit connected to said source, and means for maintaining the anode current flow of said device constant with variations of the voltage of said source due to variations in the current of said load circuit flowing through the internal resistance of said source, said means comprising a resistor connected in series between said load circuit and source at the terminal of said source to which said cathode is connected, and means connecting the junction of said resistor and load circuit to said control grid, said resistor having a value \( R \) determined by the expression:

\[
R = DR_1
\]

wherein \( D \) is the inverse of the voltage amplification factor of said device, and \( R_1 \) is the internal resistance of said source.

4. An amplifier circuit comprising an amplifier device having a control electrode, an operating supply source having a substantial internal resistance, a load circuit having substantial current fluctuations, means connecting said device and said load circuit in parallel to said supply source, and means for stabilizing the operation of said amplifier device for variations in the voltage of said source due to fluctuations in the current of said load circuit, said stabilizing means comprising a resistor connected in series with said load circuit, and means connecting the junction of said resistor and load circuit to said control electrode, said resistor having a value \( R \) determined by the expression:

\[
R = DR_1
\]

wherein \( D \) is the inverse of the voltage amplification factor of said device, and \( R_1 \) is the internal resistance of said source.

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