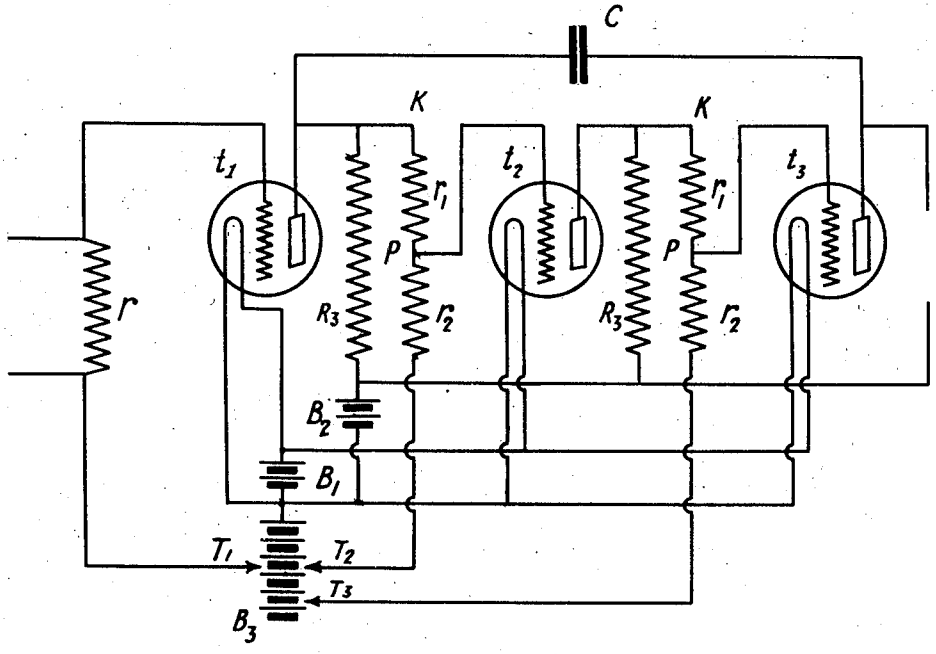
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THERMIONIC AMPLIFIER

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THERMIONIC AMPLIFIER.

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This invention relates to thermionic amplifiers, and has for its object the provision of a multi-stage direct current amplifier in which all the thermionic valves employed are operated from common batteries or the like.

In multi-stage direct current thermionic amplifiers hitherto constructed, separate additional batteries in some part or parts of the circuit are employed, in order to apply to the grids of the valves the potential bias necessary for good amplification.

According to the present invention the necessary potential bias for all the valves is obtained from a common battery by means of potentiometric connections thereto in conjunction with suitable resistances or other impedances.

With this arrangement common anode cathode and grid batteries may be employed.

In one way of carrying out the invention, as applied to a multi-stage cascade amplifier, the cathodes of the valves are supplied with energy in the usual way from a common cathode battery, and the anode cathode circuits are completed each through a separate anode resistance and a common anode battery. The resistance of a separate potentiometer is connected between each anode and a tapping point on a bias battery common to all the valves. For each valve therefore the potentiometer and bias battery are in parallel with the anode resistance and anode battery in the anode cathode circuit.

A dividing point on each potentiometer divides the resistance thereof into first and second portions, and the said point is connected to the grid of the valve next that to whose anode the said first portion is connected.

In operation, the grid of the first valve is adjusted to the desired magnifying point by means of the bias battery. The anode of the first valve is connected to the second grid through a potentiometric circuit. The bias effect of the bias battery on the second valve is adjusted by the tapping point, and the dividing point coupling the potentiometer to the second valve can therefore be adjusted to any desired positive or negative potential with reference to the cathode. Subsequent stages in the amplifier are adjusted in a similar manner.

Suppose the portions of the resistance of the potentiometer are equal, and that the electro-motive force from anode to cathode of the first valve is equal to the electro-motive force between the cathode and the tapping point on the bias battery, then the second grid will be at zero potential with regard to the cathode. If the anode cathode potential difference on the first valve now drops, by, say 10 volts, then the dividing point on the potentiometer will become 5 volts negative with reference to the cathode assuming the anode resistance to be of relatively small value.

By making the first portion of the resistance of the potentiometer a fraction of the second, and increasing the voltage applied by the bias battery to obtain correct potential distribution, it is possible to obtain substantially full magnification from each stage in the amplifier. The total resistance of the potentiometer should be large compared with the anode resistance, and the amplifier should be adjusted so that no grid currents flow.

The invention is illustrated in the accompanying diagram.

In this diagram t^1, t^2 and t^3 are triodes whose cathodes are supplied with energy in the usual manner from the common battery B^1, and the anode cathode circuits are completed each through a separate resistance R^3, and a common anode battery B^2. The resistances of separate potentiometers K are connected between each anode and tapping points T^2 and T^3 on a bias battery B^3 common to all the triodes. For each anode therefore the potentiometer K and bias battery B^3 are in parallel with the resistance R^3 and anode battery B^2 in the anode cathode circuit.

A point P on each potentiometer K divides the resistance thereof into two parts r^1 and r^2, and is connected to the grid of the triode next to that to whose anode r^1

is connected. The point P is adjustable.

In operation, the input voltage is applied across a resistance r in the grid circuit of the first triode, or in any other known manner, the grid of the first triode t^1 being adjusted to the desired magnifying point by means of the tapping point T^1 on the battery B^3. The anode of the first triode is connected to the second grid through the potentiometric circuit. The bias effect of the battery B^3 on the second triode is adjusted by means of the tapping point T^2, and the point P coupling the potentiometer to the second triode can therefore be adjusted to any desired positive or negative potential with reference to the cathode. If the anode cathode potential difference on the first triode now drops by, say, 10 volts, then the point P will become 5 volts negative with reference to the cathode, assuming R^3 to be of relatively small value and to be equal to r^2.

The value of r^1 and r^2 should always be high compared with that of R^3. By making r^1 a small fraction of r^2 and increasing the voltage applied by the battery B^3 to obtain correct potential distribution it is possible to obtain substantially full magnification from each stage in the amplifier. The output from the triode t^3 can be employed in any known manner.

The amplifier should, of course, be adjusted so that no large grid currents flow, as such currents would disturb the potential distribution.

In some cases, as when a high degree of amplification is required, it may be necessary to employ anti-reaction condensers to prevent spurious oscillations within the system; for this purpose a condenser may be connected between the anodes of triodes t^1 and t^3 as shown at C in the diagram, or it may be inserted in the circuit in any other well known manner.

Having described my invention, what I claim is:

1. In a multi-stage thermionic amplifier, a plurality of tubes, each provided with an anode circuit including a resistance, a source of positive anode potential, a potentiometer and high potential biasing body in parallel with said resistance and potential source, and a means associated with said potentiometer for obtaining a negative bias on the grid of each tube of the amplifier.

2. In a multi-stage thermionic amplifier, a plurality of tubes, an anode circuit for each tube including a resistance and a source of positive potential, a potentiometer having one end point connected to the anode and the other end point to a grid bias battery, said potentiometer and bias battery being connected in parallel with said anode resistance and potential source, a connection from an intermediate point on said potentiometer to the grid member of the following tube of said amplifier, and means for biasing said grid member which includes adjusting the negative potential of said biasing battery to overcome the positive potential in said direct connected anode circuit.

3. A multi-stage thermionic amplifier comprising a plurality of potentiometers in conjunction with resistances, a single biasing battery for all the thermionic valves, means by which the said potentiometers may control the bias on the grid members of each of the thermionic valves from the single biasing battery, said means comprising the connecting of the grid members of the second and following valves to a tapping point on each of the said potentiometers, said potentiometers being connected at one end to the anode member of the preceding valve and at the opposite end to a tapping point on the said common biasing battery and in parallel with the anode resistance of the preceding valve and the anode battery common to each of the said valves.

4. In a multi-stage thermionic amplifier, a plurality of tubes each provided with a resistance and source of positive potential in the tube output circuit, a second tube input circuit including a potentiometer and series connected grid biasing body in parallel with said resistance and potential source, a connection between an intermediate point on said potentiometer and the grid member of each succeeding tube in the said amplifier, and means for adjusting the potential on said second tube input circuit including a portion of the potentiometer and biasing battery for overcoming the positive potential reaching said tube input circuit from the directly connected output circuit of the preceding tube whereby the said grid members may be negatively biased.

5. In a multi-stage thermionic amplifier, a plurality of thermionic tubes, each provided with a resistance and series connected source of high potential in the tube output circuit, a direct connection between the anode member of each tube and the grid member of each succeeding tube, said connection being made through potentiometers having their tapping points connected to the grid member of each tube, a high potential biasing battery having the negative terminal connected to the third point of each of said potentiometers, said connection being adapted to impress on each of said grid members a negative potential of sufficient strength to overbalance the positive potential impressed on said grid from the output circuit of the preceding tube whereby the said grid member may be negatively biased.

6. In an inter-tube coupling, an anode circuit for the first tube, a resistance and source of high positive potential contained in said anode circuit, a potentiometer and high volt-

age biasing battery connected in parallel with said resistance and source of positive potential of said anode circuit, a connection between the grid member of the second tube and a point on said potentiometer, and means for negatively biasing said second grid member to overcome the positive potential impressed from the anode circuit of the first tube, said biasing means including the varying of the amount of negative potential supplied to said group until the said negative potential overcomes the said positive anode potential.

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