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AMPLIFIER WITH HEATER COMPENSATION

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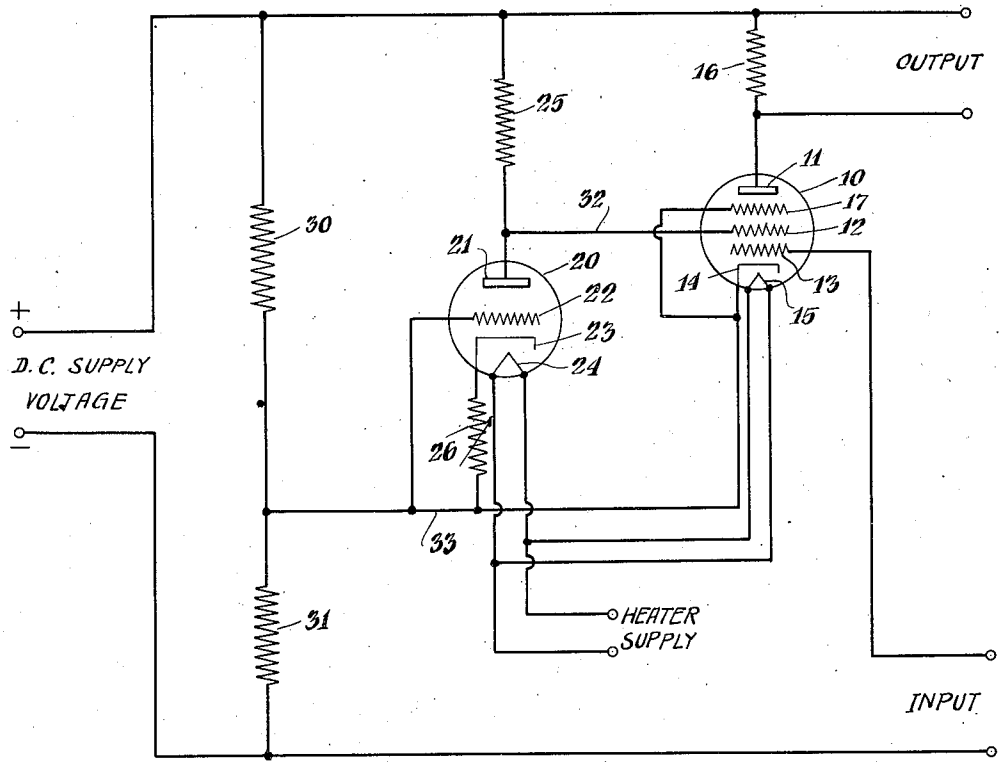
Fig. 1



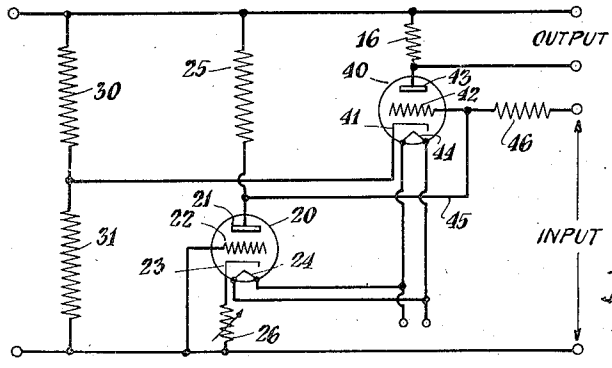


Fig. 2

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AMPLIFIER WITH HEATER COMPENSATION

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5 Claims. (Cl. 179—171)

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The invention relates to a compensating means or circuit which compensates for variations in heater voltage of an amplifier tube. The cathode heater of a tube is customarily connected with a transformer to supply the energy for the heater. If there are changes in the supply voltage the heater becomes hotter or colder depending upon the variation and consequently causes an increase or decrease in electronic emission from the cathode and in the current through the tube. In order to compensate for such variations in heater or cathode voltage the compensating circuit is used so that the amplifier tube is insensitive to variations in heater voltages.

It is an object of the invention to construct a new and novel circuit which compensates for variations of the heater voltage of the tube.

Another object is to construct a circuit which compensates for variations of heater voltage by varying the voltage upon a grid of the tube in accordance with variations in heater voltage or temperature so that the amplifying tube is insensitive to heater variations.

A still further object of the invention is to construct a compensating circuit or means in which variations in the heater voltage produce a corresponding variation in the voltage applied to the screen grid of a pentode amplifier.

Other objects of the invention will be more apparent from the following description taken in connection with the accompanying drawings which illustrate two embodiments thereof in which

Figure 1 shows a diagrammatic circuit illustrating an amplifier tube and a control tube for varying the potential applied to the screen grid of the amplifier tube as the heater voltage varies.

Figure 2 shows a diagrammatic circuit utilizing a triode as the amplifying tube.

The compensating circuit of Figure 1 includes an amplifier tube 10 having at least a pair of grid electrodes, the tube illustrated being a pentode having a plate or anode 11, screen grid 12, control grid 13, a suppressor grid 17, cathode 14 and the cathode heater 15. A resistance 16 provides impedance means connected to the anode of the tube to provide a load therefore. The resistance 16 is connected with the high potential side of a D. C. supply voltage. The output circuit connection or terminals are connected across the resistance 16, that is between the anode 11 of the tube 10 and a point of fixed or substantially fixed potential. The input terminals or connection apply the signal to the control grid 13 as will appear hereinafter.

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In order to compensate for variations in the heater voltage a tube 20 is provided, which is illustrated as a triode although a three element tube is not necessary, having an anode or plate 21, and a cathode 23, which may be and is illustrated as an indirectly heated one and hence has a cathode heater 24. Preferably the tube is a triode and has a control grid 22. The cathode heaters 15 and 24 of the two tubes are connected together so that current is supplied thereto from the same source, the connection illustrated being in parallel. A resistance 25 is connected with the plate or anode of the tube 20 to provide a load therefor and its other end is connected with the high potential end of a voltage divider or the D. C. potential source. A resistance 26 may be connected with the cathode 23 to provide the proper control grid bias for the triode and may be variable in order to provide the desired compensation.

Preferably a voltage divider is provided which is adapted to be connected across a source of D. C. supply voltage. The voltage divider shown includes resistances 30 and 31 connected in series. The plate circuit of the compensating tube 20 and the screen grid 12 of the tube 10 are directly connected by a connection 32 which connection is illustrated as being directly with the plate 21 of the tube. The bias resistor 26 and the cathode 14 of the amplifier tube are connected with the voltage divider at a point spaced from the low potential end or at a point between the resistances 30 and 31. The two tubes therefore shunt a portion of the voltage divider. The resistance 31 supplies a proper negative bias for the control grid 13 of the amplifier tube 10.

In operation the amplifying tube 10, which may be designated a second tube, operates as an amplifier in known fashion. If however, the cathode heater voltage should increase the plate current of the tube would increase and thereby introduce an undesired increased voltage drop through the resistor 16. In order to compensate for this increase in current flow through the tube 10, the tube 20, which may be designated a first tube, is provided and since this latter tube is excited from the same source of heater supply, this tube also will have an increased flow of plate or anode current with the same increase in heater voltage. This increased current through the tube 20 will result in an increased potential drop across the resistor 25 and thereby lower the voltage applied to the screen grid 12. This lowering of the screen grid potential will decrease the current through the amplifier tube 10 by an amount

equivalent to the increase caused by the increased temperature and increased emission of the cathode, and hence compensate for the tendency to increase the current occasioned by the increased heater voltage.

In Figure 2 a circuit is illustrated in which the amplifying tube is a triode. Corresponding parts are numbered similarly to Figure 1 and need not be again described. It should be noted however, that the compensating tube **20** is connected with the negative side of the voltage supply rather than to the voltage divider as illustrated in Figure 1. In other words the compensating tube and its anode resistance **25** preferably shunts the entire voltage divider **30, 31** when a triode is used as the amplifying tube.

The amplifying tube **40** has a cathode **41**, control grid **42** and anode **43**. The tube illustrated has an indirectly heated cathode and hence is heated by a cathode heater **44**. The heaters of both tubes are connected with the same source of current supply. Since the amplifying tube is a three element tube, the anode circuit of the compensating tube **20** is connected by the connection **45** with the control grid **42**. The connection preferably is with the plate **21** of the compensating tube. A resistance **46** is also connected with the control grid which for A. C. amplification, may be substituted by a condenser.

The compensating circuit illustrated in Figure 2 operates in the same manner that the circuit of Figure 1 operates except that the voltage to compensate for heater variation is applied directly to the control grid of the amplifying tube rather than to a screen grid.

This invention is presented to fill a need for improvements in a compensating circuit. It is understood that various modifications in structure, as well as changes in mode of operation, assembly, and manner of use, may and often do occur to those skilled in the art, especially after benefiting from the teachings of an invention. Hence, it will be understood that this disclosure is illustrative of preferred means of embodying the invention in useful form by explaining the construction, operation and advantages thereof.

What is claimed is:

1. A heater compensating amplifier circuit comprising a voltage divider adapted to be connected across a source of D. C. voltage; a first space discharge tube having a cathode, control grid and anode, a bias resistance in series with the cathode, a connection between the control grid and the low potential side of the bias resistance which is its sole connection, a resistance connected with the anode of said tube, and the tube and resistance connected in shunt with at least a portion of the voltage divider; a second space discharge tube having a cathode, control grid, a screen grid and an anode, an output circuit connected with the anode of the second tube and a point of fixed potential; means connecting together the cathode heaters of both tubes for supply from the same source of heater current; a D. C. conducting connection from the anode of the first tube to the screen grid of the second tube, and input connections for the second tube between the control grid and the cathode whereby plate current of the second tube is rendered substantially free from changes in cathode emission.

2. A heater compensating amplifying circuit comprising a voltage divider adapted to be connected across a source of D. C. voltage; a first space discharge tube having a cathode, and anode, a resistance connected with the anode of the first tube, the tube and the resistance being connected in shunt with at least a portion of the voltage divider, and the cathode of the tube being connected at a point spaced from the low potential side of the voltage divider; a second space discharge tube having a cathode, control grid, a screen grid and an anode, an output circuit for the second tube, and the output circuit and second tube being connected across a portion of the voltage divider, the cathode of the tube being connected at a point spaced from the low potential side of the voltage divider; means connecting together the cathode heaters of both tubes for supply from the same source of heater current; a D. C. conducting connection from the anode of the first tube to the screen grid of the second tube; and input connections with the ccnrol grid of second tube and the low potential side of the voltage divider whereby plate current of the second tube is rendered substantially free from changes in cathode emission.

3. A heater compensating amplifying circuit comprising a voltage divider adapted to be connected across a source of D. C. voltage; a first space discharge tube having a cathode, control grid and anode, a resistance connected with the anode of the first tube, a bias resistance connected with the cathode, a connection between the control grid and the low potential end of the bias resistance which is its sole connection, the tube and the resistances being connected in shunt with at least a portion of the voltage divider, and the cathode of the tube being connected at a point spaced from the low potential side of the voltage divider; a second space discharge tube having a cathode, control grid, a screen grid and an anode, an output circuit for the second tube, and the output circuit and second tube being connected across a portion of the voltage divider, the cathode of the tube being connected at a point spaced from the low potential side of the voltage divider; means connecting together the cathode heaters of both tubes for supply from the same source of heater current; a D. C. conducting connection from the anode of the first tube to the screen grid of the second tube; and input connections with the control grid of the second tube and the low potential side of the voltage divider whereby plate current of the second tube is rendered substantially free from changes in cathode emission.

4. A heater compensating amplifying circuit comprising a first space discharge tube having a cathode, control grid and anode, a resistance connected with the anode of the first tube and adapted to be connected with a source of D. C. voltage, a bias resistance connected with the cathode of the first tube, and a connection from the control grid to the low potential side of the bias resistance and being the sole connection therebetween, a second space discharge tube having a cathode, control grid, screen grid, and an anode, a resistance connected with the anode of the second tube and adapted to be connected with a source of D. C. potential, the cathode of the second tube being connected with the low potential side of the bias resistance of the first tube; bias means connected with the cathode of the second tube and in series with the bias resistance of the first tube; means connecting together the cathode heaters of both tubes for supply from the same source of heater current; a D. C. conducting connection from the anode of the first tube to the screen grid of the second

tube; and input connections with the control grid of the second tube and the bias means whereby plate current of the second tube is rendered substantially free from changes in cathode emission.

5. A heater compensating amplifying circuit comprising a voltage divider adapted to be connected across a source of D. C. voltage; a first space discharge tube having a cathode, control grid and anode, a resistance connected with the anode of the first tube and with the high potential end of the voltage divider, a bias resistance connected with the cathode of the tube and at a point spaced from the low potential side of the voltage divider, and the control grid being connected solely with the low potential side of the bias resistance; a second space discharge tube having a cathode, control grid, a screen grid, a suppressor grid and an anode, an output circuit connected with the anode of the second tube and with the high potential side of the voltage divider, the cathode of the second tube being connected with the voltage divider at the same point that the bias resistance of the first tube is connected therewith; means connecting together the cathode heaters of both tubes for supply from the same source of heater current; a D. C. conducting connection from the anode of the first tube to the screen grid of the second

tube; and input connections with the control grid of the second tube and the low potential side of the voltage divider whereby plate current of the second tube is rendered substantially free from changes in cathode emission.

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