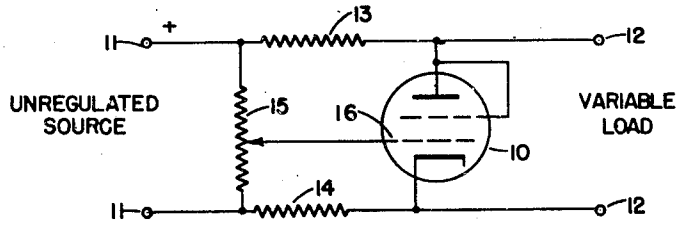
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VOLTAGE REGULATOR

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VOLTAGE REGULATOR

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This invention relates in general to an electronic voltage regulator and in particular to a direct current type of voltage regulator.

In electronic equipment which comprises one or more vacuum tube components operated from a direct current voltage source, stabilization of such source is desired and essential to the proper operating performance of the equipment. In general, the factors which cause voltage instability may be categorically classified as variations in load current, and (especially where alternating current rectification is used) variations in source voltage. It is therefore an object of this invention to provide a stabilized direct current voltage supply.

Another object of the invention is to provide a stablized direct current voltage supply of controllable magnitude.

Another object of this invention is to provide a simple vacuum tube voltage regulator circuit for stabilizing a voltage supply subjected to either variations in load current or source voltage, or both.

Other objects and features of the present invention will become apparent upon a careful consideration of the following detailed description when taken together with the accompanying drawing; the single figure of which is a schematic diagram of one embodiment of the invention.

In constructing a voltage regulator circuit in accordance with the teachings of the invention a single, high transconductance, vacuum tube is employed. This tube is so connected in the circuit together with a pair of compensating impedances that either variations in load current or source voltage will be instantaneously and properly compensated in such a manner as to provide a stabilized voltage output. In particular, one of the compensating impedances is connected in the normal path of both tube and load current flow while the other compensating impedance is so associated with the tube and the path of load current flow that a change in load current will cause an immediate and reverse change to occur in tube current flow through the first compensating impedance. Such variations in tube current are made equal and opposite to variations in load current flow to thereby maintain a constant voltage drop across the first compensating impedance and hence a stabilized voltage drop across the tube. Means are also provided for coupling variations in source voltage to the grid of the regulator tube so as to cause similar variation in tube current flow through the first compensating impedance. Such variations in tube current flow are

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adjusted so that the resulting variations in voltage drop which occur across the compensating impedance are equal and opposite to the variations in the source voltage to thereby maintain a constant voltage drop across the tube.

In the drawing a typical embodiment of the invention is illustrated. The single vacuum tube component 10 of the invention is connected across the input terminals 11 to which the unregulated source is applied, with the polarity as indicated. A first compensating impedance 13 is connected in series with the input and output terminals 11 and 12, between input terminal 11 and the plate of tube 10, so that both the load and plate currents flow therethrough. The second compensating impedance 14, is connected in series with the lower terminals 11 and 12 between the grid and cathode electrodes of the tube. Potentiometer 15 is connected across input terminals 11 and is adapted to communicate source voltage variations directly to control grid 16.

Compensation for variations in load current are brought about by impedance 14. To illustrate, let it be assumed that an increase in load current has occured. Such increase, without impedance 14 in the circuit, will cause an increase in voltage drop to occur across impedance 13 and hence a drop in the output voltage across terminals 12. With impedance 14 in the circuit, however, the increase in load current flows in its return path through impedance 14 to thus drive the cathode of tube 10 in a positive direction. As it does so tube 10 is effectively biased more negative and the tube current component flowing through impedance 13 decreases by the same amount that a load current increases. The normal voltage drop occurring across impedances 13 and 14 has not, therefore, changed and the voltage across terminals 12 is stabilized for varying load conditions. Potentiometer 15 provides an adjustment of the tube transconductance and therefore an adjustment of the linearity of the regulator circuit. Potentiometer 15 also provides an adjustment of the normal tube current flow and hence an adjustment in the magnitude of the stabilized voltage output appearing across terminal 12. For optimum performance under varying conditions of load the transconductance of the tube and the resistance of impedance 14 should be chosen so that their product is much larger than unity. It consequently follows that a high transconductance tube which permits a low resistance of 14 will keep the power loss at impedance 14 at a minimum.

Compensation for variations in source voltage

is brought about by impedances 13 and 14 and the signal applied to the grid of tube 10 through potentiometer 15. To illustrate, let it be assumed that a decrease in source voltage has occurred. This decrease simply appears across potentiometer 15 and is applied thereby to the grid of tube 10. Again the result is an increase in negative bias for tube 10 and hence a decrease in tube current flow through impedances 13 and 14. Decrease in the tube current component flowing through impedances 13 and 14 causes a corresponding decrease in the voltage drop thereacross. Then by adjustment of the movable tap on potentiometer 15 the proportion of the variation of source voltage applied to the grid of tube 10 can be controlled until the increase or decrease (as the case may be) of the voltage drop across impedance 13 and 14, which is caused by tube current flow, exactly offsets the variations in source voltage.

Although I have shown and described only a certain and specific embodiment of the present invention it is to be understood that I am fully aware of the many modifications possible thereof. For example, the compensating impedances 13 and 14 have been illustrated as elements independent of the filter supply system of the source applied across terminals 11 when actually they may be, if desired, composed, in part at least, by the reactors of the filter supply. Therefore this invention is not to be restricted except insofar as is necessitated by the spirit of the prior art and the scope of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. A voltage regulator circuit, comprising a high transconductance vacuum tube having at least a plate, a grid and a cathode, a first voltage dropping impedance connected in the common path of load and tube current flow, a voltage dropping resistor connected between the grid and cathode electrodes of said tube in series with the common return path of load and tube current flow, said resistor being selected so that the product of the resistance thereof and the transconductance of said tube is much greater than unity, whereby said resistor operates responsive to variations in load current flow to produce substantially equal and opposite variations in tube current flow.

2. A voltage regulator circuit, comprising a high transconductance vacuum tube having at least a plate, a grid and a cathode, a first voltage dropping impedance connected in the common path of load and tube current flow, a voltage dropping resistor connected between the grid and cathode electrodes of said tube in series with the common return path of load and tube current flow, said resistor being selected so that the product of the resistance thereof and the transconductance of said tube is much greater than unity, whereby said resistor operates responsive to variations in load current flow to produce substantially equal and opposite variations in tube current flow, and means for adjusting the average grid bias on said tube and thereby the magnitude of the stabilized voltage output.

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