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POWER SUPPLY REGULATOR SYSTEM

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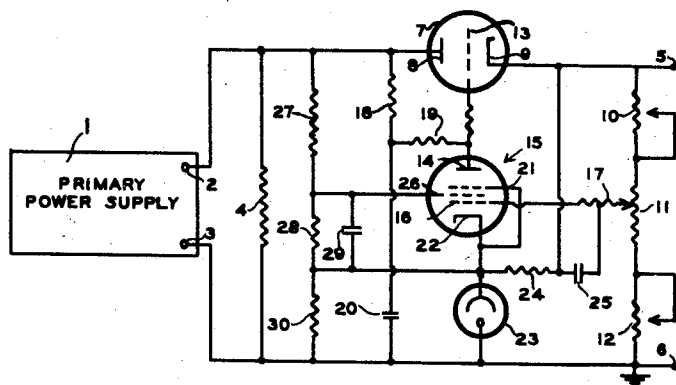


FIG. 1

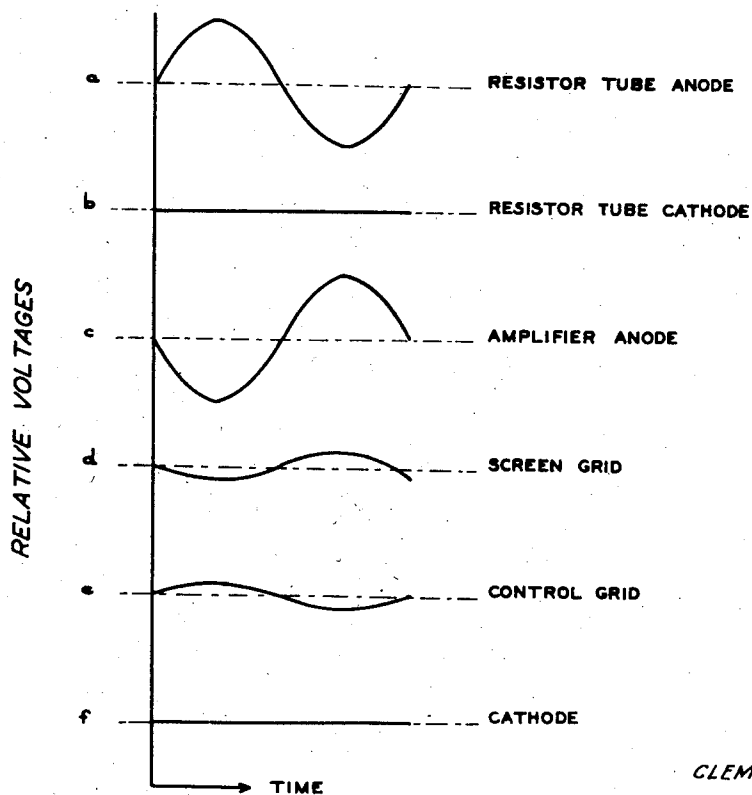


FIG. 2

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## POWER SUPPLY REGULATOR SYSTEM

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2 Claims. (Cl. 323—30)

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This invention relates to voltage regulator systems for electronic power supplies and more particularly to an improved voltage regulator circuit of the variable resistor tube type.

In certain applications of the radio art direct current energizing voltages are required in the region of 300 to 700 volts. Under certain conditions the requirements are for a very stable and constant supply at such voltages in spite of comparatively large fluctuations imposed on the supply due to the nature of the load.

It is an object of the present invention to provide an electronic voltage regulator for the purpose stated which substantially eliminates all undesirable deviations from a given voltage.

It is another object of the invention to provide an electronic voltage regulating circuit of the variable resistor tube type for a full wave rectifying power supply.

It is still a further object to provide a regulator circuit of the type referred to wherein the voltage controlling resistor tube is controlled by a pentode amplifier, the output voltage of which is modulated by output voltages of the circuit and which in addition is provided with circuit elements to cause the screen grid thereof to function as an additional control grid.

Still another object is to provide a voltage regulator circuit of the type referred to which provides substantially complete compensation for undesirable voltage fluctuations of the output voltage.

In accordance with the invention, I provide in connection with the output circuit of a fully rectified power supply a voltage regulating circuit wherein the main regulator function is exercised by a variable resistor tube. The control voltage for the said resistor tube is supplied by a pentode amplifier, the control grid of which receives a modulating voltage from the regulator output circuit as a given fraction of the output voltage available thereacross. At the same time the screen grid of the said amplifier is acting as an additional control grid by receiving a given proportion of the unregulated voltage and by having its phase compensated to such an extent that the combined action of the screen and control grids have the effect of producing a voltage in the pentode plate circuit which will influence the conductivity of the resistor tube in such a way as to substantially completely compensate for fairly large voltage in the supply circuit fluctuations and to thus assure a constant voltage output.

These and other features and objects of the invention will become more apparent upon con-

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sideration of the following detailed description to be read in connection with the accompanying drawings in which:

Fig. 1 is a diagrammatic representation in schematic form of a voltage regulator circuit in accordance with my invention; and

Fig. 2 is a series of graphical representations of the voltage relations of various circuit elements of Fig. 1.

Referring now to the circuit diagram, a primary source of rectified voltage is indicated at 1, the unregulated direct current voltage being available at its output terminals 2 and 3 which feed into an output impedance represented by a resistance 4. The voltage output across the resistance 4 is obtained at output terminals 5 and 6 of the regulator circuit. The regulation of the voltage ultimately available across 5 and 6 is obtained by means of a triode 7 which has an anode 8 connected to one side of the resistance 4, and a cathode 9 providing the output voltage for terminal 5. The regulated voltage output circuit also includes adjustable resistances 10, 11 and 12 connected in series across the two terminals 5 and 6. The triode 7 also includes a control grid 13 which receives a controlling voltage from an anode 14 of a pentode amplifier 15. The amplifier 15 is utilized for amplifying the voltage fluctuations in the output circuit between terminals 5 and 6 by having applied to control grid 16 thereof a control voltage by means of a suitable tap 17 of the resistance 11, whereby such control voltage represents a given fraction of the total output voltage. The anode potential for the amplifier 15 is obtained from the power supply 1 over resistances 18 and 19, a bypass condenser 20 being provided to the ground line. The amplifier 15 includes a suppressor grid 21 and a cathode 22 which are connected together and are subject to a biasing potential in respect to the grounded side of the circuit which is regulated by means of a glow discharge type regulator tube 23. A connection is provided from the positive side of the glow discharge tube to the positive terminal 5 over a dropping resistance 24 and to the tap 17 through a blocking condenser 25. The amplifier 15 also includes a screen grid 26 which is subjected to the controlling action of the unregulated voltage available across the resistance 4 over a dropping resistance 27. By having in its circuit, with respect to the cathode 22, a resistance 28 and a condenser 29 in parallel therewith, the screen grid has its relative bias and phase adjusted in such a manner that grid control functions are assumed by it in addition to

those exercised by the control grid 16. A connection to ground for the screen grid circuit is provided through a resistance 30.

Thus, for instance, if a positive variation occurs in the supply circuit including the resistor tube 7, a portion of this voltage variation, according to the proportion of the value of the resistances between the terminal 5 and the tap 17 to the value of the resistances between the tap 17 and the terminal 6, will be applied to the control grid 16 of the amplifier 15 to cause it to become more conductive to generate a proportionate negative potential in the anode circuit 14 thereof which is applied to the control grid 13. This in turn increases the resistance of the tube 7 to produce a greater voltage drop in the resistor tube circuit to counteract the original positive variation. In addition, the resistances 27 and 28 are proportioned in such a way, that with the addition of the condenser 29 in the screen grid circuit, the screen grid 26 also acts as a control grid, being subject to a portion of the unregulated voltage, whereby the effect of the circuit as a whole is increased to such an extent as to produce a substantially completely compensated, that is constant, voltage across the terminals 5 and 6.

In order to make the functions and relationships of the various circuit elements somewhat clearer, a reference to Fig. 2 will be made. In graph *a* an imaginary fluctuation of the power supply voltage of a sinusoidal form has been indicated, as might be encountered in the anode circuit of the resistor tube 7. In order to counteract this undesirable fluctuation, the resulting compensatory control voltage available in the anode circuit 14 of the amplifier 15 should be substantially, as shown in graph *c*, that is, if translated to a common reference, would be equal and opposite in sign to the fluctuations of graph *a*. This compensation would produce the desired steady output in the cathode circuit 9 of the resistor tube 7 as shown in graph *b*. The control voltage in respect to the control grid 16 produces an effect thereon which is indicated in *e* showing the resulting deviation from the normal as being in phase with the ordinary undesirable fluctuation as shown in graph *a*. The effect of the fluctuation on the screen grid is indicated in graph *d* where the wave form shown is also representative of the deviation from the normal, rather than indicating an absolute voltage condition. The constant voltage shown in graph *f* is that available in the cathode circuit 22 of the amplifier 15 due to the action of the voltage regulator 23. The presence of the condenser 29 has the effect of adjusting the phase relationship of the screen grid potential in respect to that of the anode circuit and therefore to that of the original fluctuations of graph *a*. Thus, in conjunction with the proper proportion of the resistances 27 and 28, a complete compensation is achieved by means of the additional control action obtained from the screen grid as described. The suitability of the relative proportion of the two resistances of the screen grid circuit is determined by the completeness with which any undesirable fluctuations are compensated by the amplifier 15 and the resistor tube 13 in view of the inherent characteristics of these two tubes.

I have found that the circuit described is particularly useful where a steady direct current voltage is required under conditions ordinarily producing large fluctuations, and that it is quite

practical up to about 700 volts output, one such use being the replacement of a B battery eliminator.

While the above is a description of the principles of this invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of this invention.

I claim:

1. A voltage regulator circuit of the resistor tube type for use with a unidirectional voltage source having a supply and an output circuit, comprising a resistor tube having an anode, a grid and a cathode in said supply circuit for regulating the voltage therein; a control amplifier tube having an anode, a screen grid, a control grid and a cathode, bridged with a series resistance across said supply circuit, means for applying the anode circuit voltage of said amplifier to said resistor tube grid, means for applying to said control grid a proportion of the voltage across said output circuit comprising a resistance thereacross, an impedance network comprising a resistance and a condenser across said supply circuit for supplying therefrom control voltage to said amplifier screen grid and cathode and suitable phase correction to said screen grid respecting said cathode, whereby said screen grid acts as an additional control and substantially complete compensation is obtained for a range of voltage fluctuations.

2. A regulator circuit for use with a unidirectional voltage source having a supply circuit and an output circuit comprising a resistor tube having an anode, a grid and a cathode in said supply circuit for regulating the voltage in said output circuit; a pentode amplifier having an anode, a screen grid, a control grid and a cathode connected across said supply circuit; means for applying the anode circuit voltage of said amplifier to said resistor tube grid; resistance means connected across said output circuit; means for obtaining a given proportion of the output voltage across said resistance means connected to said control grid; a resistance capacitance network across said voltage supply circuit for apportioning the available voltage as between the screen grid, the amplifier cathode and ground; the capacitance of said network comprising a phase correcting capacitor between said screen grid and said cathode; and a voltage regulator in the cathode to ground circuit of said amplifier, whereby said screen grid acts as an additional control and substantially complete compensation is obtained for a range of voltage fluctuations.

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