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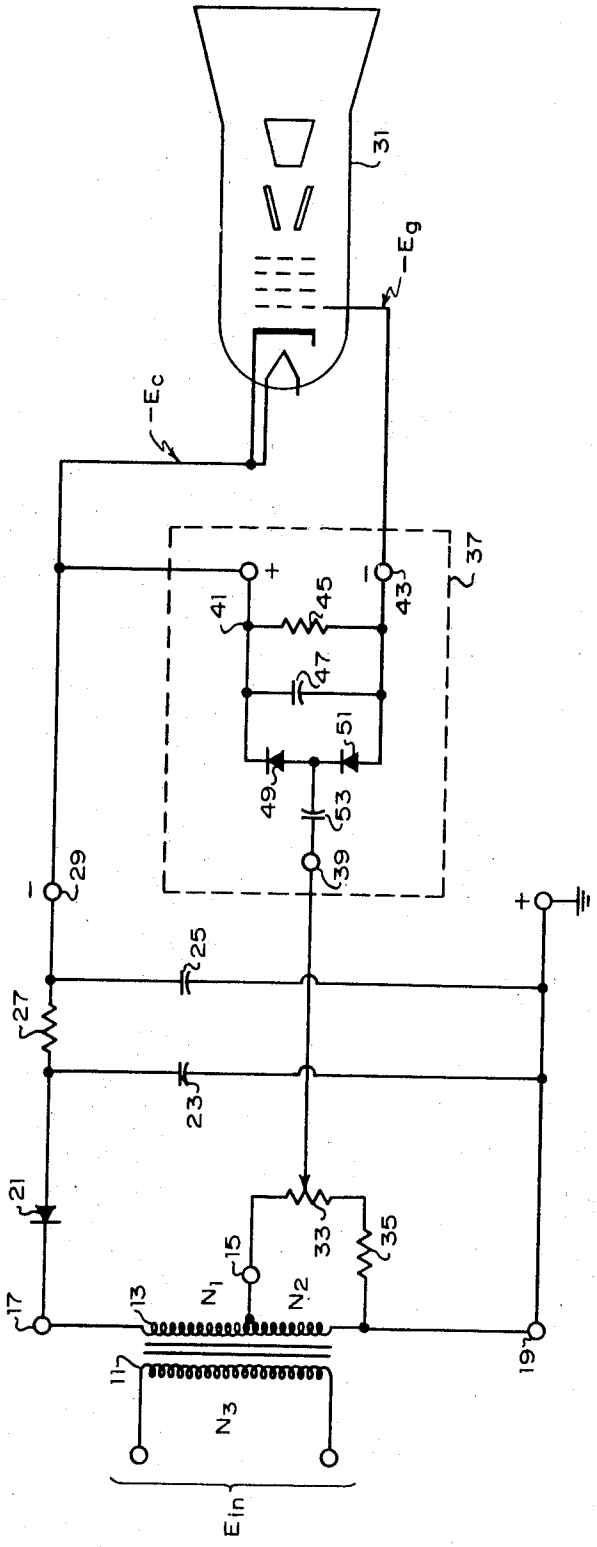

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POWER SUPPLY HAVING INCREMENTALLY RELATED HIGH VOLTAGE OUTPUTS

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ABSTRACT OF THE DISCLOSURE

A circuit produces two high D.C. output voltages having values on the order of 3000 volts and separated in magnitude from one another by a low voltage increment. A power transformer with a single secondary winding provides both high and low voltages, which are independently rectified and filtered. The low voltage rectifying and filtering circuit is a voltage multiplier, which is referenced to the high D.C. voltage. A potentiometer connected to the input of the voltage multiplier permits accurate adjustment of the incremental output voltage.

BACKGROUND OF THE INVENTION

A high voltage component, such as a cathode ray tube, generally is powered by several high voltages which are closely and critically related to one another. For example, if the cathode electrode of such a tube is driven at —3000 volts, the control grid of the tube should be biased with a slightly more negative predetermined voltage on the order of —3100 volts. Preferably the grid bias voltage is easily and accurately adjustable within a narrow voltage range and is stable with time and temperature. Typical prior art power supplies that provide two incrementally related high voltages employ a power transformer having two secondary windings which drive separate rectifiers and filters. Since both secondary windings must be heavily insulated, the power transformer is generally large and expensive. Also, proper operation is achieved only after carefully equalizing the rectification and filtering attenuation of each circuit. Generally, the output of the bias voltage rectifier and filter is adjusted by a potentiometer. Since the output is on the order of several thousand volts, this arrangement has the disadvantage that adjustments of a few volts are difficult to make. Additional problems result because the potentiometer is subjected to the full high voltage output. For example, undesirable changes in the resistance of the potentiometer may occur due to variations in temperature and humidity.

SUMMARY OF THE INVENTION

The illustrated embodiment of the present invention includes a power transformer having a single high voltage secondary winding which is tapped to provide a source of low voltage. The high voltage is rectified, filtered and applied to an output terminal. The low voltage from the tap of the secondary winding is adjusted by a voltage divider and then rectified and filtered by a voltage multiplier having a capacitively coupled input. The output of the low voltage source is connected to the high voltage output terminal and provides a small voltage increment which is referenced to the high voltage source. The voltage increment is utilizable as a bias voltage, for example, and can be accurately adjusted by the voltage divider to any desired value within a broad range. Since the voltage divider operates at low voltages, it requires little insulation from ground potential and is not affected by reasonable variations in humidity and temperature.

BRIEF DESCRIPTION OF THE DRAWING

The single figure of the drawing is a schematic diagram illustrating the preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the figure, there is shown a high voltage power supply including a power transformer having primary and secondary windings **11, 13**, respectively. The secondary winding **13** is tapped at an intermediate terminal point **15** to define upper and lower sections (as viewed in the drawing) having a turns ratio $N_1:N_2$ on the order of 50:1. The number of turns N_3 on the primary winding is selected on the basis of the input voltage E_{in} and the desired output voltages. Preferably, E_{in} is about 12 volts A.C., and the secondary winding output voltage is about 6000 volts peak-to-peak.

The high voltage appearing across the two end terminals **17, 19** of the secondary winding **13** is half-wave rectified by a diode **21** and then filtered by a network including two capacitors **23, 25** and a resistor **27**. Terminal **19** is referenced to ground; and a high negative D.C. voltage, on the order of 3000 volts, is obtained from output terminal **29**. In the illustrated embodiment of the present invention, output terminal **29** is connected to a cathode ray tube **31** and provides the high negative cathode voltage, $-E_c$; however, it is to be noted that the power supply circuit described herein may be also used to drive other high voltage components.

In the case where the upper and lower sections of the secondary winding **13** have the aforementioned turns ratio of 50:1 and the total secondary winding output is 6000 volts peak-to-peak, the output across the tap point terminal **15** and terminal **19** is 120 volts peak-to-peak. This low voltage is adjustable within a predetermined range by a potentiometer **33** which is connected in a voltage divider configuration with a resistor **35**.

The movable arm of potentiometer **33** is connected to a low voltage D.C. supply **37**, which is a peak-to-peak voltage rectifier or multiplier having an input terminal **39** and positive and negative output terminals **41, 43**, respectively. The output terminal **41** is connected directly to the output terminal **29** of the high voltage power supply. Coupled in parallel between the low voltage terminals **41, 43** are a load resistor **45**, a capacitor **47** and two series connected diodes **49, 51**. The common junction of diodes **49, 51** is A.C. coupled to the low voltage input terminal **39** through a capacitor **53**.

In operation of the voltage multiplier **37**, capacitor **53** is charged through diode **49** and the filtering network of the high voltage power supply during the positive half-cycle of the low voltage input to terminal **39** (i.e. when tap point terminal **15** is more positive than terminal **19**). During the negative half-cycle of the low voltage input, capacitor **47** is charged by current flowing through capacitor **53**, diode **51** and the high voltage power supply. The capacitor **47** is charged to a voltage equal to the sum of the positive peak voltage across capacitor **53** and the negative peak voltage input to terminal **39**. Thus diodes **49, 51** conduct on alternate one-half cycles to charge capacitors **53, 47**, respectively, and the total D.C. voltage across terminals **41, 43** is the peak-to-peak value of the A.C. voltage input to terminal **39**. Load resistor **45** functions to discharge capacitor **47** when the transformer input voltage E_{in} is disconnected.

The output voltage of the low voltage D.C. supply **37** is referenced to the high negative D.C. voltage at terminal **29** by the aforementioned connection between terminal **29** and terminal **41**. Therefore the negative output voltage from terminal **43** will be related to the negative

voltage from terminal **29** by a small voltage increment which can be easily adjusted by potentiometer **33**. In the illustrated embodiment of the invention, the negative D.C. output voltage from terminal **43** is used to provide the grid bias voltage $-E_g$ for cathode ray tube **31**.

I claim:

1. A circuit for producing two high voltage outputs related to one another by an incremental value, said circuit comprising:

means providing a source of high D.C. voltage including:

a transformer having primary and secondary windings, said secondary winding having two end terminals and an intermediate tap at a predetermined low voltage point near one of said end terminals; and

rectifying and filtering means connected to the end terminals of said secondary winding, said rectifying and filtering means having a high voltage output terminal connectable to a load;

means providing a source of low D.C. voltage having a magnitude less than the voltage at said high voltage output terminal, said low D.C. voltage source means having a capacitively coupled input terminal, and two opposite polarity output terminals;

means connecting the input terminal of said low D.C. voltage source means to the intermediate tap of said secondary winding; and

means connecting the high voltage output terminal of said high D.C. voltage source means to one of said two opposite polarity output terminals of said low D.C. voltage source means, thereby to reference the voltage at the other one of said two opposite polarity

output terminals to the voltage at said high voltage output terminal.

2. The circuit of claim **1**, wherein said low D.C. voltage source means comprises voltage multiplier means including:

a first capacitor connected between said two opposite polarity output terminals;

two diodes coupled in series through a common junction, said two series coupled diodes being connected in parallel with said first capacitor; and

a second capacitor connected in series between the common junction of said two diodes and said input terminal.

3. The circuit of claim **2**, said voltage multiplier further including load resistor means connected in parallel with said first capacitor.

4. The circuit of claim **1**, said means connecting the input terminal of said low D.C. voltage source means to the intermediate tap of said secondary winding including: adjustable voltage divider means interconnecting said intermediate tap and said nearest one end terminal of said secondary winding.

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