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HIGH VOLTAGE GENERATOR

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FIG. 1

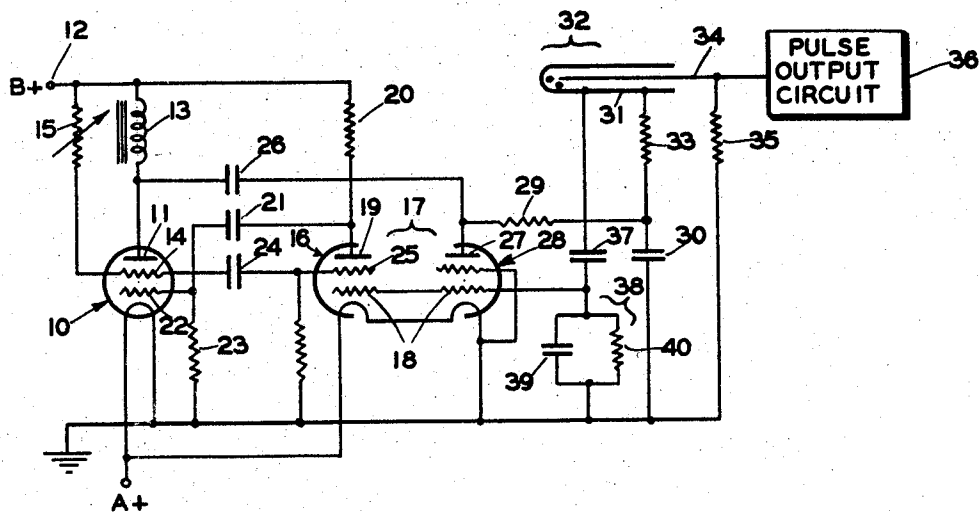
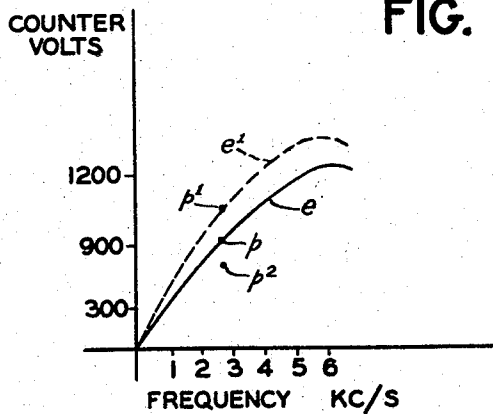


FIG. 2



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HIGH VOLTAGE GENERATOR

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Application August 20, 1954, Serial No. 451,213

8 Claims. (Cl. 250-83.6)

This invention relates to high voltage supply circuits especially adapted for providing operating voltages for Geiger-Mueller counter tubes, and is especially directed to an arrangement for maintaining uniform voltage under changing conditions of operation.

The invention is applicable to voltage supply circuits in which the high voltage is taken from a condenser charged by the supply circuit. When the counter is in operation, current is drawn from the condenser at a rate corresponding to the counting rate. As long as the rate of current withdrawal is not greater than the rate of current supply from the circuit, the voltage across the condenser will be maintained; but when the withdrawal exceeds that rate, the voltage will drop, affecting the operation of the counter.

An object of the invention is to maintain the voltage applied to the counter at the desired value with varying counting rates, and in particular when such rates produce a current drain in excess of the normal current supply.

Another object is to provide means for automatically varying the energy supply to a counter voltage source in accordance with variations in the counting rate, thereby maintaining a uniform voltage at said source.

In accomplishing these objects, the invention comprises the generation of a D.C. compensating voltage that is proportional to the counting rate, and the utilization of such voltage to increase the electrical energy fed to the counter voltage supply so as to balance the tendency of the supply voltage to drop with increased counting rates.

A specific object is to utilize an integrating network to regulate the compensating voltage, connecting it to the counter circuit so that the voltage across the network will be proportional to the counting rate.

Another object is to provide a counter voltage generating circuit having a variable output, and to vary such output automatically by means of said compensating voltage. A specific object is to operate a multivibrator circuit in this manner. A related object is to utilize a space charge tube, regulating its output in the indicated manner by varying the voltage applied to the space charge grid.

Other objects are to provide a high voltage supply circuit of the indicated type that will have very low plate power requirements, will be smaller and lighter than previous high voltage supply circuits for similar purposes, and which will be reliable and adapted for quantity production.

The foregoing and other objects and advantages of the invention will appear more fully from consideration of the detailed description which follows, in conjunction with the accompanying drawing, wherein one embodiment of the invention is illustrated. It is to be expressly understood, however, that the drawing is for the purposes of illustration and description, and is not to be construed as defining the limits of the invention.

In the drawing;

Fig. 1 is a diagram of a counter voltage generating circuit embodying the invention, and

Fig. 2 is a graph illustrating the operation of the circuit.

The illustrated embodiment is of the type already indicated, in which sawtooth waves generated by a relaxation oscillator are applied across a high inductance, such as a choke coil, the high voltage generated by the rapid decay of each wave being applied to the counter. A circuit of this type is disclosed in application Serial No. 197,000,

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filed November 22, 1950, now Patent No. 2,752,508 patented June 26, 1956, by the same inventor for Counting Rate Meter. In the form shown in Fig. 1, the multivibrator includes electron discharge tube 10, shown as a tetrode, with plate 11 connected to plate voltage source 12 through choke coil 13. Screen grid 14, which functions as an anode, is connected to said source through variable resistor 15.

The other multivibrator tube consists of one section 16 of a duplex space-charge tetrode 17 having a common space-charge grid 18. Plate 19 is connected to source 12 through load resistor 20, and through condenser 21 to control grid 22 of tube 10, grounded through grid bias resistor 23. Grid 14 of tube 10 is in turn connected, through condenser 24 with the second grid 25 of tube, section 16, which functions as a control grid. This arrangement forms a multivibrator of well-known type.

Plate 11 of tube 10 is connected through blocking condenser 26 with the plate 27 of the second section 28 of tube 17, which functions as a rectifier when the highly positive pulse generated across choke 13 is applied to plate 27. The resulting output is integrated, being applied through resistor 29 across condenser 30, which is thus charged to a voltage value determined by the average repetition rate and amplitude of the pulses of fixed amplitude generated by the multivibrator in conjunction with choke coil 13.

The voltage across condenser 30 may be adjusted by changing either the frequency of the multivibrator or the amplitude of the generated pulses. A variable element for changing the frequency is provided, the illustrated circuit utilizing variable resistor 15 for this purpose.

The positive voltage across condenser 30 is applied through load resistor 33 to the outer electrode 31 of the Geiger-Mueller counter tube 32, referred to herein simply as the counter or counter tube. The inner electrode 34 of said counter tube is grounded through load resistor 35, and is connected to a pulse output circuit 36, such as the circuit disclosed in the above-mentioned patent application Ser. No. 197,000.

An arrangement is provided for increasing the voltage output of the multivibrator circuit in proportion to current demands on condenser 30 caused by operation of counter 32 and exceeding the normal output of said circuit, thereby counteracting the tendency toward voltage drop across the latter condenser under such circumstances. This is accomplished by providing an integrating circuit charged in accordance with the rate of generation of pulses by counter 32, and connected to the multivibrator circuit in such manner that the output of the latter circuit is increased in proportion to the integrating circuit charge, thereby maintaining a steady potential on the counter 32 regardless of variations in the counter pulse rate.

In the form illustrated, the counter electrode 31 is connected through blocking condenser 37 to integrating circuit 38, consisting of condenser 39 and resistor 40 in parallel, and to space charge grid 18 of duplex tetrode 17, the other side of said circuit 38 being grounded. With this arrangement the voltage across circuit 38 will be proportional to the frequency of the pulses developed in counter 32, and will correspondingly increase the emission of tetrode 17 by its effect on grid 18. This will similarly increase the amplitude of the pulses from the multivibrator circuit, and consequently the potential of the output of said circuit across condenser 30. The circuit is designed so that this tendency to produce an increase in potential will balance the tendency to reduce the potential of counter electrode 31 due to increased drain on condenser 30, thereby stabilizing the voltage applied to the latter electrode by the described circuit.

The operation of the circuit is graphically illustrated

in Fig. 2. The full line graph e indicates the voltages applied at different frequencies to electrode 31 of the counter 32 by a selected circuit of the illustrated type, the desired voltage being obtainable by regulating the frequency, as by adjusting the value of resistor 15. The result of increasing the amplitude of the multivibrator output pulses is illustrated by dotted graph e^1 , which shows the effect of applying a given positive voltage to the space charge grid 18. However, said voltage will be developed across integrator network 38 only by the generation of counter pulses at a given rate, which will draw current from condenser 30 and thus tend to reduce the electrode voltage by the value of said voltage. Consequently the tendency to reduce the counter voltage caused by a given frequency of counter pulses will be balanced by an increase in multivibrator output amplitude, automatically maintaining a steady counter voltage.

For instance, assume that a counter voltage of p (Fig. 2) is desired, and is maintained by operating the multivibrator circuit at a selected frequency when the counter is not generating pulses, and that the counter pulse rate is such that it would drop the counter voltage to the point p^2 if not corrected. A voltage proportional to the counter rate will be developed across integrating network 38, applying a corresponding positive voltage to space grid 18 that will increase the amplitude of the multivibrator output, which will then be located on the graph e^1 , with a voltage value p^1 at the selected operating frequency. The values are chosen so that the increased energy supply from the multivibrator due to the increased counting rate will balance the increased drain on condenser 30 due to said rate increase, and compensate for the resulting tendency of the voltage across condenser 30 to drop. Consequently the voltage applied to counter 32 will remain substantially at the value p , regardless of variations in the counting rate.

Although but one embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

I claim:

1. A stabilized high voltage generating circuit for counter tubes and the like, comprising means for generating a high voltage to energize a counter tube, means for generating a compensating voltage proportional to the counting rate of said tube, and means for varying the output of the high voltage generating means in accordance with variations in said compensating voltage and thereby maintain a uniform counter tube energizing voltage at different counting rates.

2. A stabilized high voltage generating circuit for counter tubes and the like, comprising means for generating a high voltage to energize a counter tube, including means responsive to a compensating D.C. voltage for automatically varying said generated high voltage to maintain uniform counter tube energizing voltage at different counting rates, and means for generating said compensating D.C. voltage in accordance with the counting rate of said tube, including an integrating network connected to the counter tube, and means for charging said network in accordance with the frequency of counter tube pulses.

3. A stabilized high voltage generating circuit for counter tubes and the like, comprising means for generating a high voltage to energize a counter tube, including a relaxation oscillator, means for varying the frequency of the output of said oscillator, means for varying the amplitude of said output, and means for adjusting the oscillator output to compensate for the effects of changing counting rates, including means coupled to an input of said oscillator for actuating said frequency varying means and means connected to the counter tube

to actuate the amplitude varying means in accordance with the counting rate.

4. A stabilized high voltage generating circuit for counter tubes and the like, comprising a high voltage generating circuit to energize a counter tube, including a space charge electron discharge tube having a space charge grid, means for generating a compensating voltage proportional to the counting rate of said counter tube, and means for varying the output of the generating circuit and thereby maintain a uniform counter tube energizing voltage by applying said compensating voltage to the space charge grid.

5. A stabilized high voltage generating circuit for counter tubes and the like, comprising a high voltage generating circuit to energize a counter tube, including a space charge electron discharge tube having a space charge grid, means for generating a compensating voltage proportional to the counting rate of said counter tube, including an integrating network and means for charging said network in accordance with the frequency of counter tube pulses, and means for varying the output of the generating circuit and thereby maintain a uniform counter tube energizing voltage, including means for applying said compensating voltage from the integrating network to said space charge grid.

6. A stabilized high voltage generating circuit for counter tubes and the like, comprising a high voltage generating circuit to energize a counter tube, including a relaxation oscillator having a space charge electron discharge tube provided with a space charge grid, means for generating a compensating voltage proportional to the counting rate of the counter tube, and means for applying said compensating voltage to the space charge grid and thus varying the voltage output of said circuit in accordance with variations in the counting rate, whereby the energizing voltage to said counter tube will be maintained at a substantially uniform value for different counting rates.

7. A stabilized high voltage generating circuit for counter tubes and the like, comprising a high voltage generating circuit for a counter tube, including a relaxation oscillator having two electron discharge tubes, one of which is a space discharge tube having a space discharge grid, a choke coil in the output of the oscillator, arranged to generate high voltage pulses, a rectifier for said pulses, comprising a space discharge tube having a space discharge grid, and means for maintaining the voltage to the counter tube at a stabilized value for different counting rates, comprising means for generating a voltage proportional to the counting rate and applying said voltage to said space discharge grids.

8. A stabilized high voltage generating circuit for counter tubes and the like, comprising a high voltage generating circuit for a counter tube, including a relaxation oscillator having two electron discharge tubes, one of which is a space discharge tube having a space discharge grid, a choke coil in the output of the oscillator, arranged to generate high voltage pulses, a rectifier for said pulses comprising a space discharge tube having a space discharge grid, an integrating network for said pulses connected between the rectifier and the counter tube, and means for maintaining the voltage to the counter tube at a stabilized value for different counting rates, comprising means for generating a voltage proportional to the counting rate, including an integrating network connected to the counter tube, and means for applying voltage from the latter integrating network to said space charge grids.

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