

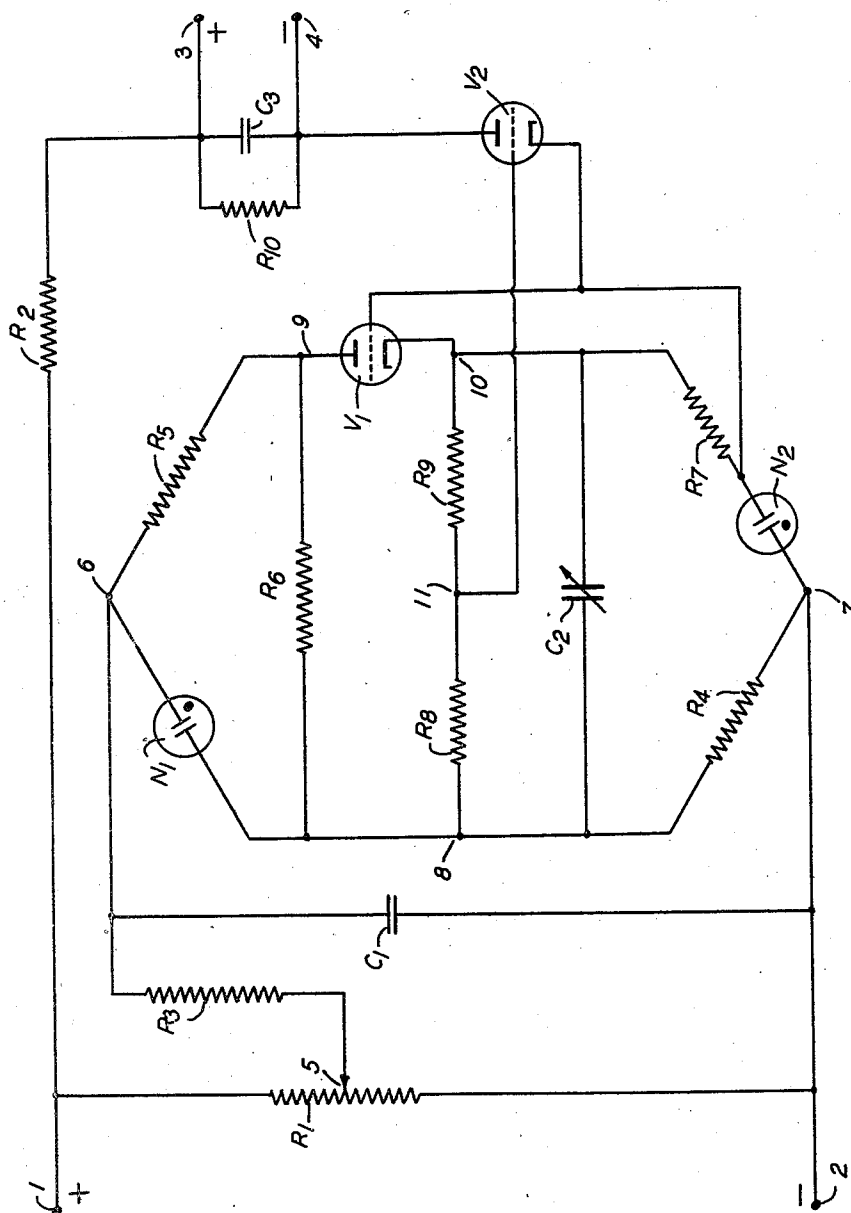
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VOLTAGE CONTROL CIRCUIT

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VOLTAGE CONTROL CIRCUIT

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This invention relates to voltage control. More particularly it relates to means for automatically and periodically varying the direct-current potential applied to specific points in a circuit such as on the various electrodes of electronic tubes.

In many instances it is desirable to alter the direct-current potential of a point in an electrical or radio circuit within a predetermined range and in accordance with a predetermined period of variation. One method of accomplishing this has been to vary such voltage by use of a motor driven potentiometer. This has grave disadvantages arising from the fact that a sliding contact on the potentiometer is required. Most important of these disadvantages are the introduction of noise in radio circuits, variability in results due to changes in temperature and to the presence of oxidation and dirt, and the short life of such a potentiometer due to wear at the contacts. The use of a multivibrator eliminates the disadvantages of sliding contacts but is limited in its use because it has not been found practical to alter the pulse width without altering the pulse repetition frequency.

It is an object of the present invention to provide a periodically variable voltage supply which eliminates sliding contacts and thus eliminates the disadvantages inherent in them.

It is also an object of this invention to provide a condenser controlled supply of direct-current potential derived from a primary constant direct-current potential source.

It is a further object of the present invention to provide a supply of pulsating direct-current potential from a constant direct-current potential source in which the pulse repetition frequency and width of the output pulses may be varied independently.

Other objects, features, and advantages of this invention will suggest themselves to those skilled in the art and will become apparent from the following description of the invention taken in connection with the accompanying drawing.

Referring now to the drawing, which is a schematic diagram of a circuit embodying the principles of the invention, a potentiometer R_1 is connected at terminals 1, 2 across a source of constant direct-current potential. The high potential end of potentiometer R_1 is connected through resistor R_2 to the high potential terminal 3 of the output terminals 3, 4 of this voltage supply. Between adjustable contact 5 on potentiometer R_1 and the low potential end of the potentiometer are resistor R_3 and capacitor C_1 in series with each other. Parallel to capacitor C_1 and between

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points 6 and 7 there is connected a network including a voltage divider, two gas filled diodes, and two vacuum triodes. Normally nonconducting gas filled tube N_1 is connected in series with resistor R_4 between circuit points 6 and 7. In series with each other and shunting tube N_1 , resistors R_5 and R_6 are connected between circuit points 6 and 8. Resistor R_5 together with triode V_1 , resistor R_7 , and normally nonconducting gas filled tube N_2 form another path between points 6 and 7. The plate of tube V_1 is connected to circuit point 9 between resistors R_5 and R_6 . Resistor R_7 is in the cathode lead of tube V_1 being connected between gas filled tube N_2 and cathode terminal 10. Variable capacitor C_2 is connected to form a path between circuit point 3 and cathode terminal 10 shunting resistor R_4 , gas filled tube N_2 , and resistor R_7 . Vacuum tube V_2 has its cathode connected directly to the grid of tube V_1 and has a bias on its grid obtained from a voltage divider comprising resistors R_8 and R_9 . The grid of tube V_2 is connected at point 11 between these resistors which are themselves connected between circuit point 3 and cathode terminal 10. The plate of tube V_2 is connected to the low potential terminal 4 of the output terminals which are across capacitor C_3 in turn shunted by resistor R_{10} .

For operation from a 220 volt direct-current supply, at a pulse repetition frequency of in the neighborhood of 20 cycles with a peak voltage output range of 6 to 10 volts, the following values are given by way of example: R_1 10,000 ohms, R_2 50,000 ohms, R_3 100,000 ohms, R_4 100,000 ohms, R_5 150,000 ohms, R_6 1 megohm, R_7 5 megohms, R_8 10 megohms, R_9 10 megohms, R_{10} 10 megohms, C_1 .01 mfd., C_2 0-300 mmfd., and C_3 .1 mfd. It is to be understood that these values may be varied both overall and in relation to each other and depend upon the characteristics of the tubes used and the characteristics of the output potential.

Following there is a description of the manner in which this circuit operates to produce the desired results: The position of contact 5 on potentiometer R_1 is chosen for the desired frequency of operation and, as above stated, once chosen remains fixed for that particular frequency. A direct-current voltage is applied across points 1 and 2 and a portion of this voltage appears between contact 5 and the low potential end of potentiometer R_1 . This voltage charges capacitor C_1 through resistor R_3 to the point where the break-down potential is applied to gas filled tube N_1 . When this point is achieved tube N_1 breaks down and discharges capacitor C_1 . The potential

across tube N₁ then drops, N₁ is extinguished, and the cycle repeats at a frequency determined by values of resistor R₃ and capacitor C₁ and the applied constant direct-current voltage. Resistors R₄, R₅, R₆, constitute a voltage divider which splits the voltage of the charge on capacitor C₁ in such a manner that gas filled tube N₁ breaks down before gas filled tube N₂ breaks down. Most of the voltage across this voltage divider is across resistor R₆. When no current is flowing through resistor R₇, there is no bias on vacuum tube V₁ and the polarities are such that tube V₁ presents a very low resistance during the period when capacitor C₁ is being charged.

As soon as gas filled tube N₁ breaks down a potential appears across resistor R₄ equal to the original charge on capacitor C₁ less the ionizing potential of gas filled tube N₁. This voltage on resistor R₄ plus the high voltage on capacitor C₂ is sufficient to break down tube N₂. Capacitor C₂ slowly discharges through resistor R₄, tube N₂ and resistor R₇. The time of discharge of capacitor C₂ is determined by the charge on that capacitor which is variable. The peak voltage to which capacitor C₂ charges is constant so that the charge is a function of the capacity of capacitor C₂. When capacitor C₂ has partially discharged, tube N₂ is extinguished. Capacitor C₂ cannot discharge through tube V₁ because polarities are wrong. It is to be noted that the potential on capacitor C₁ cannot be applied to capacitor C₂ until tube N₂ has been extinguished because the discharge current through resistor R₇ biases tube V₁ beyond cut-off.

Before tube N₂ breaks down the cathodes of tubes V₁ and V₂ are at the same potential, and a negative cut-off bias is applied to tube V₂ by the voltage divider action of resistors R₅ and R₆. As soon as tube N₂ breaks down, the positive voltage on the cathode of V₂ drops and the grid bias now existing causes the impedance of tube V₂ to be small compared with that of resistor R₂. Current flows through resistor R₂ charging capacitor C₃. This current flows so long as the decreasing grid potential on tube V₂ exceeds the constant cathode bias, that is, ionizing potential of tube N₂ by the amount equal to the cut-off bias of the tube. Shortly after tube V₂ cuts off, the potential on tube N₂ is decreased and tube N₂ is extinguished. No current now flows in resistor R₇, the cut-off bias is removed from tube V₁ and a charging potential is again applied to capacitor C₂, so that the cycle repeats itself when the voltage on capacitor C₁ has reached sufficient level.

Capacitor C₃ has been discharging through resistor R₁₀ but recharges with each pulse the amount of charge being determined by the pulse length. The voltage on capacitor C₃, that is, the output voltage depends upon the amount of the charge and so is variable as the charge per unit time varies with the capacity of capacitor C₂. It is thus seen that by varying the setting of potentiometer R₁ the output pulse repetition frequency may be varied without affecting the pulse width and that by varying the capacity of capacitor C₂ the output pulse width is changed without affecting the pulse repetition frequency.

While there has been here described what is at present considered to be the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention.

What is claimed is:

1. A pulse generator of independently adjustable pulse width and frequency comprising: a first capacitor; a main discharge circuit for said capacitor comprising a first discharge tube and resistor in series; means to charge said capacitor at an adjustable rate to determine the pulse frequency; an auxiliary discharge circuit for said first capacitor in parallel with said main circuit comprising controllable means and a second resistor and discharge tube in series, said first discharge tube and said controllable means being connected to the same terminal of said capacitor; a second capacitor having one terminal connected between said first discharge tube and resistor and the other terminal connected between said controllable means and said second resistor, means responsive to current flow in said second resistor to prevent current flow in said controllable means, and means to adjust the discharge rate of said second capacitor through said second resistor and discharge tube to determine the width of the pulse discharge through said second discharge tube.

2. A pulse generator of independently adjustable pulse width and frequency comprising: a first capacitor, a main discharge circuit for said capacitor comprising a first discharge tube and resistor in series; means to charge said capacitor at an adjustable rate to determine the pulse frequency; an auxiliary discharge circuit for said first capacitor in parallel with said main circuit comprising the plate cathode circuit of a thermionic tube and a second resistor and discharge tube in series, said first discharge tube and the plate of said thermionic tube being connected to the positively charged terminal of said capacitor; a second capacitor having one terminal connected between said first discharge tube and resistor and the other terminal connected between the cathode of said thermionic tube and said second resistor, the grid of said thermionic tube being connected between said second resistor and said second discharge tube to prevent current flow in said thermionic tube when current flows in said second resistor, and means to vary the discharge rate of said second capacitor through said second discharge tube and resistor to determine the width of the pulse discharge through said second discharge tube.

3. A pulse generator as in claim 2 including a thermionic output tube having a cathode connected between said second resistor and said second discharge tube, a grid connected to a voltage divider across said second capacitor, and a plate connected through a load impedance to a source of positive potential, whereby said output tube conducts only while said second discharge tube is conducting and does not charge said second condenser.

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