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H. C. GRANT, JR

1,967,303

VOLTAGE CONTROL

Filed Feb. 2, 1928

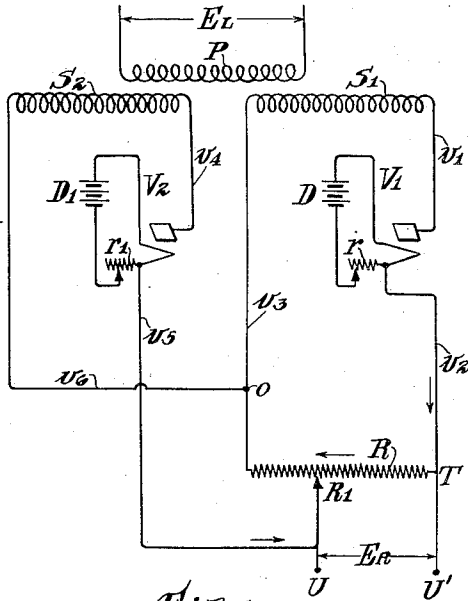


Fig. 1.

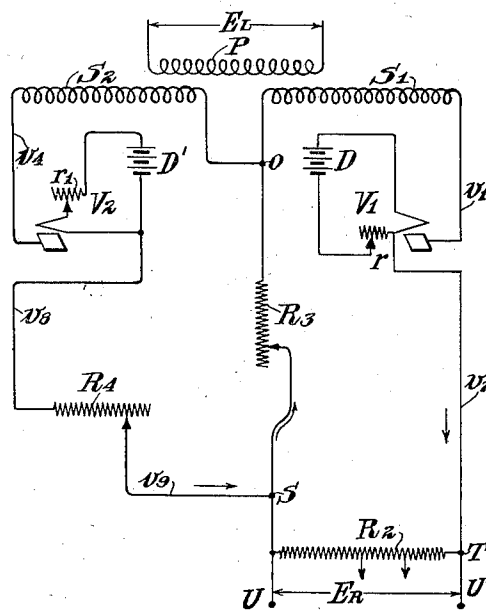


Fig. 2.

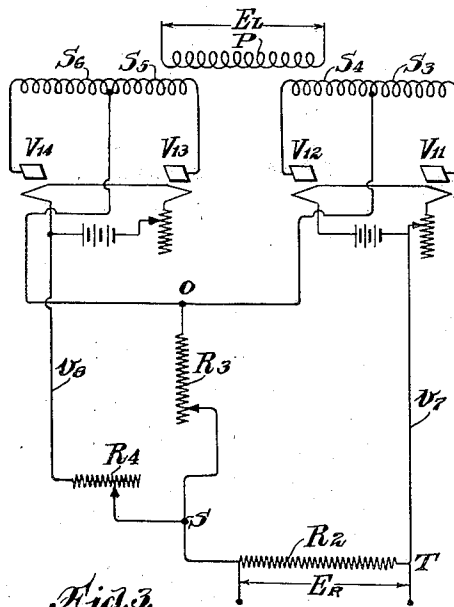


Fig. 3.

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VOLTAGE CONTROL

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Application February 2, 1928, Serial No. 251,322

10 Claims. (Cl. 175—363)

This invention relates to devices for maintaining a constant voltage supply for operating apparatus which is sensitive to changes in voltage or difference of potential and requires a current supply of constant voltage for its correct operation. Where such a device is designed to function upon changes in voltage or difference of potential, it is very necessary that the current supplied to it normally be at constant voltage, and the present invention resides in a device for maintaining such constant voltage regardless of fluctuations of voltage in the source of current.

In the copending application Ser. No. 251,321 filed February 2, 1928, there is described a method for maintaining a constant voltage which utilizes a negative bias on the grid of a three-element vacuum tube varying in proportion to the variations of the plate voltage. In this manner, the changes in the voltage of each element counteract each other and a constant voltage in the output results. The present invention is based upon the same fundamental principle of utilizing the variations of two currents taken from a common varying source to neutralize each other, thereby producing a constant output, but uses potentials of different magnitudes upon resistance elements to produce a current of unvarying characteristics.

An object of this invention, therefore, is to produce an output current of constant voltage by rectifying an alternating input current of varying voltage, impressing the rectified current across a resistance, and applying a second rectified current, differing in magnitude from the first, across a portion of the resistance, the second rectified current varying in proportion to the variations in the first rectified current.

Other objects will be apparent as the invention is described in greater detail and reference will now be had to the accompanying drawing, wherein:

Figure 1 is a conventional illustration of the circuits required for one embodiment of the invention.

Figure 2 is a conventional illustration of another embodiment of the invention wherein greater capacity for adjustment is provided.

Figure 3 is a conventional illustration of an embodiment similar to that shown in Figure 2, but showing an arrangement of circuits which utilizes full-wave rectification.

Referring particularly to Figure 1, the primary P of a suitable transformer is connected across a source of power having a voltage E_L . S_1 and S_2 are secondaries of the transformer, the former being connected to the plate of a two-element

thermionic valve V_1 by wire v_1 . The filament of this tube is heated by means of a battery D through a variable resistance r . The filament of tube V_1 is connected to a resistance R by a wire v_2 and the other terminal of the resistance R is connected to the secondary S_1 through wire v_3 . In like manner, the two-element thermionic valve V_2 is connected to the secondary S_2 by a wire v_4 , and the filament is heated by battery D_1 connected through a variable resistance r_1 . The filament of the tube V_2 is connected through wire v_5 with a variable contact R_1 on the resistance element R. Wire v_6 connects the secondary S_2 with wire v_3 at point O. The voltage E_R across terminals U, U' which are connected respectively with the variable contact R_1 and the point T is the output voltage regulated to maintain a constant value.

An unregulated varying voltage is applied across the primary P of the transformer. The secondaries S_1 and S_2 joined at the point O are connected to the respective thermionic valves V_1 and V_2 , the outputs of each of the secondaries being separately rectified by the respective thermionic valves which act as half-wave rectifiers. The voltage of the secondary S_1 is applied through the tube V_1 across the resistance R from which any intermediate voltage E_R may be tapped.

As an initial consideration, the ratios of the secondaries to the primary are first selected to give the desired voltages, or outputs.

The output of the secondary S_2 is made to pass through a portion of the resistance R, represented as that portion between the contact R_1 and point O. For the connections shown, the value of the current from secondary S_2 must always greatly exceed, or dominate that from secondary S_1 . In this manner, there will be a differential which will be a measure of the output current supplied at constant voltage from terminals U and U'. By an initial adjustment of the resistance R and proper adjustment of the output of the secondary S_2 relative to the output of the secondary S_1 , the voltage E_R will remain constant regardless of voltage changes in the unregulated input voltage E_L . If the voltage E_L rises, the potentials at points T and R_1 both rise proportionately, causing the difference in potential or voltage between the points R_1 and T to remain unchanged. The reverse action occurs upon a drop in the input voltage.

In the embodiment of the invention shown in Figure 2, the resistances are apportioned in the respective circuits to afford a greater degree of

adjustability. Instead of a single resistance R as in Figure 1, two resistances R_2 and R_3 are provided. Secondaries S_1 and S_2 are connected together at O and the plates of the thermionic valves V_1 and V_2 are connected to the respective secondaries by wires v_1 and v_4 as in Figure 1. The filament of the tube V_1 is connected to resistance R_2 by wire v_7 . The point of connection with this resistance is indicated at T . Wire v_8 connects the filament of tube V_2 with a resistance R_4 , the variable contact of which is connected to the resistance R_2 by wire v_9 . The point of connection of v_9 with the resistance is indicated at S . Resistance R_3 is connected between points O and S and is of an adjustable character as clearly shown. It will be seen that the output of the secondary S_2 is impressed across resistance R_3 after passing through the resistance R_4 . The output of the secondary S_1 is impressed across the same resistance R_3 after passing through the resistance R_2 . By an initial adjustment of the resistances R_3 and R_4 with respect to the resistance R_2 , and by the proper adjustment of the output of the secondary S_2 relative to that of secondary S_1 , the voltage across the resistance R_2 will remain constant regardless of changes in the input voltage E_L .

The resistance R_2 is shown as provided with variable taps for obtaining a plurality of voltages. As explained in connection with the voltage E_R of the device shown in Figure 1, the voltage E_R across a desired portion of the resistance R_2 in Figure 2 will remain constant regardless of changes in the input voltage. If the voltage across the primary P rises, the potential at point T also rises. Simultaneous with the above rise in potential, the potential at point S rises by reason of the increase in the voltage of the secondary S_2 . By the adjustment described above, the rise and fall of the potentials at points T and S may be made such that the difference of potential, or voltage E_R , across these points, will remain constant. This is the condition striven for.

Figure 3 indicates a system similar to that shown in Figure 2 but using full-wave rectification. The secondaries S_1 and S_2 of the transformer indicated in Figure 2 are, in the system shown in Figure 3, divided into two sections S_3 , S_4 and S_5 , S_6 , respectively. In place of the single thermionic valve for each secondary, valves V_{11} and V_{12} , connected to the secondaries S_3 , S_4 , and valves V_{13} and V_{14} connected to the secondaries S_5 , S_6 are provided. The filaments of these valves are heated in the same manner as those shown in Figure 2 and the plates thereof are connected to the transformers in such manner that full-wave rectification of the output of each transformer secondary will be had. The midpoints of the two secondaries are connected together at O and the filaments of the tubes V_{11} and V_{12} are connected to the resistance R_2 by wire v_7 in a manner similar to that in which the filament of the tube V_1 is connected to this resistance in Figure 2. In like manner the filaments of valves V_{13} and V_{14} are connected to resistance R_4 by wire v_8 . It will be apparent that the output of the secondaries S_5 and S_6 is impressed across the resistance R_3 after passing through the resistance R_4 , and that the output of the secondaries S_3 and S_4 in like manner passes through the resistances R_2 and R_3 . The voltage or difference in potential across the resistance R_2 remains constant for varying values of input voltage E_L as described in connection with the circuits shown

in Figure 2. The regulated voltage supply E_R is available after proper adjustment of the resistances R_3 and R_4 and the outputs of the respective secondaries.

It will be apparent that the invention may be applied to either alternating or direct current supplies. The specific apparatus used to accomplish the rectification of the current may be varied to suit individual requirements and the invention is not to be limited save as defined in the appended claims.

I claim as my invention:

1. The method of maintaining a constant output current which comprises supplying from a given input current of varying voltage, a varying voltage across a resistance, applying a second voltage across a portion only of the resistance, the second voltage varying proportionately with the variations of the first, and obtaining from that portion of the resistance not subjected to the second voltage an output of constant voltage.

2. The method of maintaining a constant output current which comprises supplying, from a given input current of varying voltage, a varying voltage across a resistance, applying a second independent voltage from the input current across a portion only of the resistance, the second voltage varying proportionately with the variations of the first, and obtaining from that portion of the resistance not subjected to the second voltage an output of constant voltage.

3. Means for maintaining a constant output current comprising an input current of varying voltage, means to obtain from the input two currents having voltages which vary in proportion to each other, a resistance, means for impressing one varying voltage across the resistance, means for impressing the other voltage across a portion only of the resistance, and means to supply power from the portion of the resistance not subject to the second voltage.

4. Means for maintaining a constant output current comprising an input current of varying voltage, means to obtain from the input two currents having voltages which vary in proportion to each other, a resistance, means for impressing one varying voltage across the resistance, means for impressing the other voltage across a portion only of the resistance, means to vary the resistance, and means to supply power from the portion of the resistance not subject to the second voltage.

5. Means for maintaining a constant output current comprising an input current of varying voltage, means to obtain from the input two currents having voltages which vary in proportion to each other, a resistance, one portion thereof being subject to a controlling voltage, means to apply the voltage of one of the currents across the resistance, means to apply the voltage of the other current across the said portion of the resistance for controlling the voltage across the other portion, means to adjust the current flowing through the first portion, and means to supply power from the second portion of resistance, whereby the voltage of said power supply will be maintained constant.

6. Means for maintaining a constant output current comprising an input current of varying voltage, means to transform the input to two independent currents having voltages varying proportionately, means to rectify the currents independently, a resistance, means for impressing the voltage of one of the rectified currents across the resistance, means for impressing the voltage

of the other rectified current across a portion of the resistance for controlling the voltage across the remainder of the resistance, means for adjusting the second voltage, and means for supplying power from the second portion of the resistance.

7. Means for maintaining a constant output current comprising an input current of varying voltage, a transformer having two secondary windings, means to impress the input across the primary winding, means to connect the secondary windings together at the points of zero potential, thermionic valves, means to connect the plates of the valves to the other terminals of the secondaries, a resistance, means to connect one terminal thereof to the connection between the windings, means to connect the other resistance terminal to the filament of one of the valves, means to connect the filament of the other valve to an intermediate resistance point, and means to supply power from that portion of the resistance between the second resistance terminal and the intermediate point.

8. Means for maintaining a constant output current comprising an input current of varying voltage, a transformer having two secondary windings, means to impress the input across the primary winding, means to connect the secondary windings together at the points of zero potential, thermionic valves, means to connect the plates of the valves to the other terminals of the secondaries, a resistance, means to connect one terminal thereof to the connection between the windings, means to connect the other resistance terminal to the filament of one of the valves, means to connect the filament of the other valve to an intermediate resistance point, through a

variable connection, and means to supply power from that portion of the resistance between the second resistance terminal and the intermediate point.

9. Means for maintaining a constant output current from an input current of varying voltage comprising means to obtain from the input two currents having voltages which vary in proportion to each other, first and second terminals having an electrically conductive path therebetween, a third terminal in said path between the first and second terminals, means for impressing one varying voltage across the first and second terminals so that the second terminal is of a higher potential with respect to a common point of measurement than the first terminal, means for impressing the other voltage across the first and third terminals so that the third terminal is of a higher potential than the first terminal, and means to supply power of constant output from the portion of said electrically conductive path between the second and third terminals.

10. Means for maintaining a constant unidirectional output current comprising an alternating input current of varying voltage, means to convert said input current to uni-directional current, means for impressing said uni-directional current across a plurality of terminals, a vacuum tube and circuit for obtaining a second independent current of varying voltage from the input, and means for applying to one of the terminals relative to the other a voltage which varies proportionately to that of the voltage across the terminals whereby the difference in potential across the terminals will remain constant.

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45	120
50	125
55	130
60	135
65	140
70	145
75	150