

March 24, 1936.

H. C. GRANT, JR

2,035,125

VOLTAGE CONTROL

Filed Feb. 2, 1928

Fig. 1.

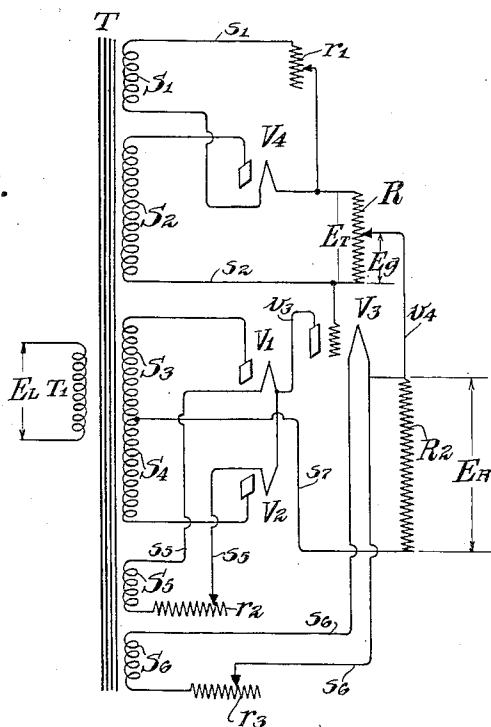
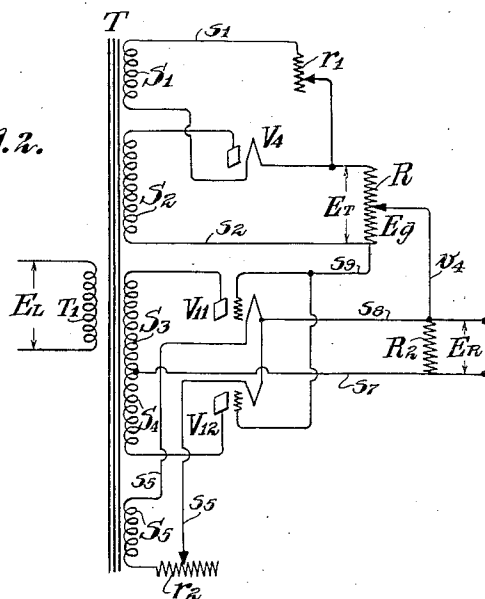


Fig. 2.



INVENTOR
Harry Campbell Grant Jr
 BY *Redding, Jolley, O'Brien*
 ATTORNEYS

UNITED STATES PATENT OFFICE

2,035,125

VOLTAGE CONTROL

Harry Campbell Grant, Jr., New York, N. Y., assignor to Walter Kidde & Company, Inc., New York, N. Y., a corporation of New York

Application February 2, 1928, Serial No. 251,321

13 Claims. (Cl. 175—363)

The present invention relates to devices for controlling the voltage of current from a source of electricity, whereby fluctuations at the source will not be impressed across apparatus to be operated by such current. There are many instances where a constant voltage is necessary for the operation of mechanism, such as fire detecting apparatus, etc., yet the location of the apparatus frequently is such that a current supply of this character is not available.

The invention has for its object the provision of a means for controlling the voltage of current from a source of electrical supply to maintain a constant value thereof across desired terminals, in spite of relatively great variations of the voltage at the source. With this condition existing at the terminals, the accuracy of indications of detecting apparatus or of the operation of any desired mechanism is unfalling.

The underlying principle involved in the maintaining of a constant voltage supply consists in creating conditions in a given device which serve to counteract the disturbance set up therein by the varying voltage supplied to the device. These conditions are created by the varying voltage and vary therewith tolerating no variation in the resulting voltage supplied.

The invention will be understood more fully in connection with the following description and the accompanying drawing, wherein:

Figure 1 is a conventional view showing the electrical circuits and connections of a device constructed in accordance with the present invention.

Figure 2 shows a modified form of the invention using three-element vacuum tubes in place of the two-element tubes used in the form shown in Figure 1.

Referring to Figure 1, the primary of a transformer T is shown at T₁ and the secondaries thereof at S₁, S₂, S₃, S₄, S₅ and S₆. The line voltage E_L of the source is impressed across the primary coil T₁ of the transformer T. This voltage, in practice, may vary between wide limits without affecting the constant voltage secured by the operation of the device described. The three secondaries S₁, S₅ and S₆ supply current for heating the filaments of vacuum tubes or thermionic valves V₁, V₂, V₃ and V₄, and the secondaries S₂, S₃ and S₄ supply plate voltages to vacuum tubes or thermionic valves V₄, V₁ and V₂, respectively. The filament circuits are designated by the characters s₁, s₅ and s₆, respectively, variable resistances r₁, r₂ and r₃ being

provided for varying the voltages across the filaments of the respective tubes.

Vacuum tubes or thermionic valves V₁ and V₂ are two-element tubes serving together as a full-wave rectifier, the rectified voltage being impressed on the plate of the three-element vacuum tube or valve V₃. Vacuum tube or thermionic valve V₄, also a two-element tube, serves as a half-wave rectifier and impresses its voltage E_r across the resistance R. The plate voltages of tubes V₁ and V₂, supplied by the transformer secondaries S₃ and S₄, the filament temperatures which are dependent upon the secondary S₅, and the resultant output of the tubes V₁ and V₂ all vary with the changes in the line voltage E_L, and any voltage obtained directly from these tubes also varies. The rectified unfiltered output of the tubes V₁ and V₂ is applied to the plate of the three-element vacuum tube V₃ through wire v₃. The current passing through V₃, varying with the plate voltage, will change in accordance with the variations in the line voltage.

In order that these changes may be corrected, the grid of the three-element tube V₃ is given a negative bias by current supplied from the tube V₄, this bias changing in accordance with the variations in the line voltage E_L. The proper bias E_g is obtained on the grid of the tube V₃ with respect to its filament by connecting the filament into the proper point of the resistance R by means of a wire v₄. To provide an initial adjustment between the wire v₄ and the resistance R, a variable contact is provided between these elements as indicated in the drawing. With the terminals of the three-element tube V₃ connected as described above, the changes in the current through the tube which are caused by reason of the variations in the plate voltage will be counteracted by the corresponding changes in the grid bias afforded through the supply from the tube V₄ and resistance R. The initial adjustment of the amount of resistance R from which is obtained the grid voltage for the grid of the tube V₃ should be such that the grid voltage is changed in the proper amount when it varies and the connections should be such that the current flow is in the proper direction. The voltage across that portion of the resistance R from which is obtained the grid voltage for the grid of tube V₃ is indicated at E_g and the resultant output voltage of the three-element tube V₃ is impressed across the resistance R₂. This voltage will be constant for all values of the line voltage E_L and may be used for the constant

voltage supply E_R . The resistance R_2 is connected through s_7 with the point of zero potential between the transformer secondary coils S_3 and S_4 and the resistance R is connected to the secondary coil S_2 through the wire s_2 .

It will be seen that the variations in the plate voltage of the tube V_3 and the grid voltage thereof occur simultaneously and in the opposite directions, that is, inversely. The proportionate changes of each are such that the resultant voltage will be constant. By the choice of tubes of similar or proper characteristics, and the proper initial adjustments of the resistances, the voltage E_g will change the correct amount to counteract the changes in the plate voltages and filament temperature of the tube V_3 . With this condition, the resulting voltage E_R and the corresponding current remain absolutely constant regardless of changes in the line voltage E_L .

A modified form of the invention is shown in Figure 2, wherein three-element vacuum tubes are used in place of the two-element tubes or valves V_1 and V_2 shown in Figure 1. The transformer T , in this case, is provided with only five secondaries S_1 , S_2 , S_3 , S_4 , and S_5 . The primary T_1 receives the line voltage E_L as in the previous design. Three-element vacuum tubes V_{11} and V_{12} are connected to the respective transformer secondaries in the manner described hereinafter. The rectifier tube V_4 is the same as used in Figure 1, being connected to the transformer secondaries S_1 and S_2 by the wires s_1 and s_2 . The resistance r_1 is connected in the filament circuit s_1 and serves as a means for varying the heating of the filament of V_4 . The plate of the tube V_4 is connected to the resistance R and the coil S_2 by wire s_2 . As in the diagram shown in Figure 1, the resistance R may be tapped by means of the wire v_4 which is connected to the resistance R_2 .

The filaments of tubes V_{11} and V_{12} are heated by current from the secondary S_5 which is connected through wires s_5 and resistance r_2 to the filaments of these tubes. The secondaries S_3 and S_4 are connected together and at the point of zero potential, are connected to the resistance R_2 by wire s_7 . The other terminals of the secondary windings are connected to the plates of the respective tubes V_{11} and V_{12} , the filaments of which are connected to the resistance R_2 through wire s_8 . The potential E_g across that portion of the resistance R which is spanned by the variable connection upon the wire v_4 , is impressed on the grids of the three-element tubes V_{11} and V_{12} . The circuits are initially adjusted so that this potential produces a negative bias upon each grid. In order that the fluctuations across the plate circuits of the three-element tubes V_{11} and V_{12} may be counteracted by corresponding fluctuations in the opposite direction and of the same magnitude on the grid terminals, the resistances are varied initially to provide the desired characteristics.

As described in connection with the circuits shown in Figure 1, the fluctuations on the plates of the three-element tubes V_{11} and V_{12} will be counteracted in view of the fact that these tubes have a negative grid bias which varies in such manner that the current flowing through the tubes will always remain constant. When the plate voltage increases the negative grid bias increases to counteract such change in the plate voltage. The resulting voltage E_R across the resistance R_2 always remains constant.

It is to be understood that any of the well known expedients now available for heating the

filaments etc. may be utilized in the system described above. The invention may be applied to either A. C. or D. C. line voltage by substitutions well known in the art and other changes may be made without departing from the scope of the invention as set forth in the appended claims.

I claim as my invention:

1. The method of providing a constant direct current output voltage which consists in rectifying a varying source of alternating current, rectifying a second supply which varies inversely as the first rectified supply to secure a potential, adjusting the magnitude of one of the supplies initially, and combining the two supplies electrically whereby a constant direct current potential will be obtained.

2. The method of providing a constant direct current output voltage which consists in rectifying a varying source of alternating current, impressing the rectified current upon the plate of a three-element vacuum tube, rectifying a second supply from the varying source, the last named supply varying in proportion to the first rectified supply, and impressing the second supply on the grid of the three-element tube to give the latter a negative bias with respect to the filament of the three-element tube, whereby the plate current will be maintained constant.

3. The method of providing a constant direct current output voltage which consists in rectifying a varying source of alternating current, impressing the rectified current upon the plate of a three-element vacuum tube, rectifying a second supply from the varying source, the last named supply varying in proportion to the first rectified supply, adjusting the voltages of the two supplies initially, and impressing the second supply on the grid of the three-element tube to give the latter a negative bias with respect to the filament of the three element tube, whereby the plate current will be maintained constant.

4. Means for maintaining a constant voltage comprising a varying alternating voltage source, means to rectify the source to produce a direct current varying in proportion to the variation of the source, means to rectify a second supply from the source to secure a potential which varies proportionately thereto, and means for impressing electrically the second rectified supply upon the first.

5. Means for maintaining a constant voltage comprising a varying alternating voltage source, a three-element vacuum tube, means to impress the source upon the plate of the three-element tube, means for rectifying a second supply which varies in accordance with the variations impressed upon the plate, and means to impress the second supply upon the grid of the three-element vacuum tube to provide the latter with a negative bias with respect to the filament.

6. Means for maintaining a constant voltage comprising a varying alternating voltage source, a three-element vacuum tube, a two-element thermionic valve, a pair of two-element thermionic valves, means to transform the current from the source, means to impress portions of the transformed current across the pair of valves to cause their half-wave rectification to produce a full-wave rectification, means to impress another portion of the transformed current across the first valve, means to supply the output of the pair of valves to the plate of the three-element tube, means to produce a negative grid bias on the grid of the three-element tube from the first named

valve, and means to supply voltage from the three-element tube to an external circuit.

7. Means for maintaining a constant voltage comprising a varying alternating voltage source, a three-element vacuum tube, a two-element thermionic valve, a pair of two-element thermionic valves, means to transform the current from the source, means to impress portions of the transformed current across the pair of valves to cause their half-wave rectification to produce a full-wave rectification, means to impress another portion of the transformed current across the first valve, means to heat the filaments of all of the valves from a portion of the transformed current, means to supply the output of the pair of valves to the plate of the three-element tube, means to produce a negative grid bias on the grid of the three-element tube from the first named valve, and means to supply voltage from the three-element tube to an external circuit.

8. Means for maintaining a constant voltage comprising a varying alternating voltage source, a three-element vacuum tube, a two-element thermionic valve, a pair of two-element thermionic valves, means to transform the current from the source, means to impress portions of the transformed current across the pair of valves to cause their half-wave rectification to produce a full-wave rectification, means to impress another portion of the transformed current across the first valve, means to supply the output of the pair of valves to the plate of the three-element tube, means to supply a portion of the output of the first valve to the grid of the three-element tube to produce a negative bias thereon, and means to supply voltage from the three-element tube to an external circuit.

9. Means for maintaining a constant voltage comprising a varying alternating voltage source, a three-element vacuum tube, a two-element thermionic valve, a pair of two-element thermionic valves, means to transform the current from the source, means to impress portions of the transformed current across the pair of valves to cause their half-wave rectification to produce a full wave rectification, means to impress another portion of the transformed current across the first valve, means to supply the output of the pair of valves to the plate of the three-element tube, means to supply a portion of the output of the first valve to the grid of the three-element tube to

produce a negative bias thereon, means to vary the voltage of the first valve impressed on the grid, and means to supply voltage from the three-element tube to an external circuit.

10. The method of providing a constant direct current output voltage which consists in rectifying a varying source of alternating current, rectifying a second supply from the source independently of the first rectified supply to secure a potential varying inversely as the first rectified supply, and combining the two supplies electrically, whereby a constant direct current potential will be obtained.

11. The method of providing a uni-directional voltage of constant magnitude, from a source of alternating current voltage varying in magnitude which comprises opposing the changes in magnitude of a uni-directional primary voltage derived from said source with a second uni-directional voltage which is derived from said source independently of the primary voltage circuit and which varies inversely with respect to the primary voltage, the magnitude of one of the voltages being capable of adjustment to a desired value.

12. The method of providing a uni-directional voltage of constant magnitude from a varying source of alternating current which comprises producing a uni-directional primary voltage from such source varying in proportion thereto, producing a second uni-directional voltage from the source independently of the primary voltage varying inversely as the variations of the primary voltage, adjusting the magnitude of one of the voltages to a desired value, and combining the two voltages to produce a uni-directional voltage supply of constant magnitude.

13. Means for maintaining a uni-directional voltage of constant magnitude comprising a varying alternating current voltage source, means to produce a uni-directional primary voltage from the source, means to produce a second unidirectional voltage from the source independently of the primary voltage circuit and varying inversely as that of the source, means to adjust the magnitude of one of the voltages to a desired value, and means to combine the two, whereby a uni-directional voltage supply of constant magnitude is obtained.

HARRY CAMPBELL GRANT, JR.

CERTIFICATE OF CORRECTION.

Patent No. 2,035,125.

March 24, 1936.

HARRY CAMPBELL GRANT, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 12, claim 1, strike out the words "to secure a potential" and insert the same after "supply" in line 11; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of April, A. D. 1936.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.

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