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MEANS FOR CONTROLLING THE VOLTAGE OF DISCHARGE DEVICES

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Fig. 1.

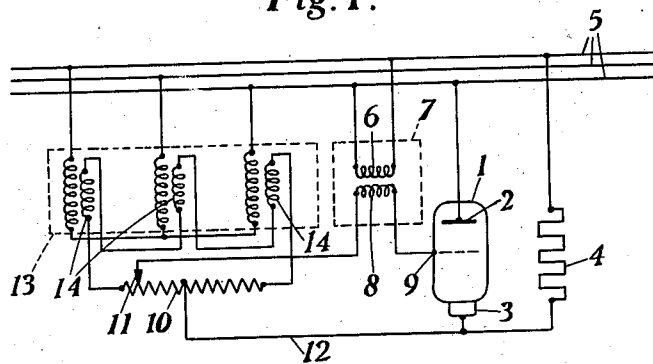
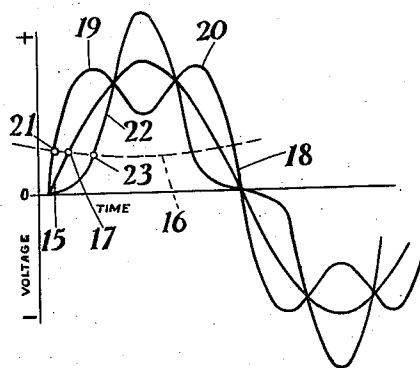


Fig. 2.



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MEANS FOR CONTROLLING THE VOLTAGE
OF DISCHARGE DEVICESHans Helmut Renner, Frankfurt-on-the-Main,
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5 Claims. (Cl. 175—363)

This invention relates to means for controlling the voltage or current of mercury arc converters or like discharge devices and particularly to means of the kind comprising a grid or control electrode to which an alternating voltage is applied that attains a critical or starting value at an instant adjustable relatively to the anode voltage. The characteristics of a discharge device may be such that at the rated voltage of the device no discharge will occur unless during the half cycle that the anode is positive, the grid is raised to a positive potential relatively to the cathode defined by a curve of critical potential which represents for each instant of anode voltage the minimum positive grid potential that will start the arc. On the other hand the characteristics of the device may be such that at the rated voltage of the device discharge occurs during the half cycle that the anode is positive unless starting of the arc is prevented by maintaining the grid at a potential sufficiently low or sufficiently negative to the cathode defined by a curve of critical potential which represents for each instant of anode voltage the minimum negative potential or the maximum positive potential that can be applied to the grid without the occurrence of starting of the arc. It has previously been proposed to effect regulation by varying the amplitude of an alternating voltage of frequency equal to the anode voltage, but in this way the maximum control that can be exerted extends over somewhat less than one half of the positive half cycle and at least over a part of the range the control exerted tends to be somewhat indefinite. It has also been proposed to exert control by varying the phase relationship between the anode voltage and an alternating or pulsating grid potential which has the same frequency as the anode voltage. In such manner regulation may be effected over the whole half cycle but the phase displacement calls for apparatus with means such as windings that may be relatively rotated or rotary switching devices. An object of the invention is the provision of an alternative method for effecting control in a definite manner. Another object is the provision of apparatus whereby the control may be exerted over a substantial part of the half cycle.

In means for controlling the voltage or current of a mercury arc or other converter comprising a grid or control electrode to which an alternating voltage is applied that attains a critical or starting value at an instant adjustable relatively to the anode voltage, according to the present invention the adjustment is made by

varying the value of a third harmonic forming part of an alternating voltage wave which is of frequency equal to that of the anode voltage and which is impressed upon the grid.

The alternating voltage wave applied to the grid is derived by adding to a fundamental voltage wave a third harmonic by means through which the amplitude and direction of the third harmonic may be adjusted.

One arrangement of mercury arc rectifier in accordance with the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawing of which Figure 1 shows an arrangement of a single phase rectifier and Figure 2 grid potential curves produced by this arrangement.

In the drawing, the rectifier 1 is of single phase construction and at the rated voltage of the rectifier the arc will strike over the greater part of the anode positive half cycle unless the grid is negative or is less positive than values defined by a critical voltage curve 16 appreciably above and nearly parallel with the line of zero voltage.

The anode 2 of the rectifier 1 is connected to one phase of a three phase power supply 5 and the cathode 3 is connected through the load 4 to another phase of the supply 5. The primary 6 of a bias transformer 7 is connected across two of the said phases and one terminal of the secondary winding 8 of the transformer 7 is connected to the grid 9 of the rectifier whilst the other terminal of the said winding is connected to a sliding contact 11 or equivalent means adapted to traverse a resistor device 10, the point whereof is connected with the cathode 3 of the rectifier over a line 12.

A current derived from the secondary windings 14 connected in open delta, of a three phase transformer 13 connected with the power supply 5, the core of which transformer is saturated during operation, passes through the resistor device. Thus a current having a frequency thrice that of the power supply flows through the resistor device.

When the sliding contact 11 is in the mid-position of the resistor device 10 a potential of substantially pure sine wave form is applied to the grid 9. The wave is represented on Figure 2 at 15. The potential is in phase with the anode voltage and the point 17, determined by the slope of the potential curve near the zero voltage line, at which the said curve 15 cuts the critical voltage curve 16 determines the time of striking of the arc.

If the sliding contact 11 is moved in one direction from the mid-point of the resistor device 10, the potential impressed on the grid 9 includes a third harmonic component which tends to give
 5 a resulting potential curve 18 with two humps 19, 20, the said curve cutting the critical voltage curve 16 at 21. The result is that the curve slopes up more steeply from the zero line and the arc strikes at an earlier period, the degree
 10 to which the striking is expediated depending upon the position of the contact 11 and the amplitude of the third harmonic.

If, on the other hand, the sliding contact 11 is moved in the other direction from the mid-point
 15 the potential impressed on the grid includes a third harmonic component which tends to give the potential curve a central hump, as shown in curve 22, cutting curve 16 at 23. The result is that the curve slopes up less steeply from the
 20 zero line and the arc strikes at a later period, the degree to which the striking is retarded depending upon the position of the contact and the amplitude of the third harmonic.

The grid voltage will not in every case be in
 25 phase with the anode voltage, but will be arranged to suit the type of transformer connection employed for the rectified and the range of control required.

I claim:

30 1. Means for controlling the output of a vapour electric converter associated with an alternating voltage circuit of the kind including a cathodic electrode, an anodic electrode and a control electrode to which control electrode is applied an
 35 alternating voltage that attains a critical or starting value at a prearranged instant, comprising means adapted to provide a potential including an alternating voltage of sine wave form having a
 40 periodicity equal to that of the voltage of the said circuit and the third harmonic of the said alternating voltage, a transformer connected in
 45 said control circuit, said transformer having a saturable core and an open delta secondary winding including a resistor device, said resistor device
 50 being connected across said transformer secondary between said control electrode and the cathode electrode by a center tapping and an adjustable tapping, the latter being arranged to adjust the value of the third harmonic present in
 55 said potential.

2. In combination, a plurality of electric circuits, including an alternating supply circuit and a direct current power circuit, a vapor electric converter interconnecting said circuits, said
 60 converter having cathode, anode and grid electrodes, a grid circuit for said converter for supplying the grid electrode with alternating potential of the same phase as the supply circuit, a circuit including wave-form control means comprising a variable resistor device cooperating with
 65 a saturated transformer for imposing on said grid circuit a third harmonic component which in combination with said component of the same phase as the supply circuit is adapted to control the power transmitted by the converter, the wave-form resulting from the two components having a decided peak, and means for varying the amount and direction of flow of the component from said resistor device for varying the position of said
 70 peak relative to the neutral line of the wave.

3. Means for controlling the output of a vapor electric converter having anode, cathode and con-

trol electrodes and taking operating current from an alternating current supply circuit, comprising a voltage transformer connected across the alternating current circuit and arranged to provide a fundamental sine wave voltage for said
 5 control electrode with a periodicity equal to that of the supply circuit, a three phase transformer connected across said alternating supply circuit for providing a third harmonic voltage, and adjustable means for the third harmonic voltage
 10 comprising a resistor device connected across the secondary of the three phase transformer and centrally connected to said cathode while the voltage transformer supplying the fundamental
 15 sine wave voltage is connected to the control electrode by a tapping adjustable relatively of the resistor device for varying the amplitude and phase of the third harmonic voltage applied to the fundamental sine wave voltage and controlling the discharge between the anode and
 20 cathode.

4. Means for controlling the output of a vapor electric converter having anode, cathode and control electrodes, comprising a three phase alternating current supply, said converter being connected to one phase of said three phase supply,
 25 a single phase transformer connected across one phase of said supply and arranged to supply said control electrode with alternating current voltage of the same sine wave form and frequency as said
 30 supply, a three phase transformer connected across said supply and arranged to provide a third harmonic alternating current voltage of sine wave form but at three times the frequency of the supply, a resistor device in circuit with said
 35 three phase transformer comprising a resistor having a central tapping connection with the cathode electrode and an adjustable tapping connection through said single phase transformer to the control electrode arranged for adjustment
 40 relative to the resistor on either side of said central tapping for varying the wave peak of the voltage on the control electrode and controlling the discharge between the anode and cathode of the converter.

5. Means for controlling the output of a vapor electric converter having anode, cathode and control electrodes, comprising a three phase alternating current supply, said converter being connected to one phase of said three phase supply,
 50 a single phase transformer connected across one phase of said supply and arranged to supply said control electrode with alternating current voltage of the same sine wave form and frequency as said
 55 supply, a three phase transformer connected across said supply and arranged to provide a third harmonic alternating current voltage of sine wave form but at three times the frequency of the supply, a resistor device in circuit with said three
 60 phase transformer, comprising a resistor having a central tapping connected with the cathode electrode and a tapping connected with the control electrode and movable along the resistor on one side or the other of said central tapping to vary the amplitude and from one side to the other
 65 for inverting the phase of the sine wave of the third harmonic for varying the wave peak of the voltage on the control electrode and controlling the discharge between the anode and cathode of the converter.

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