

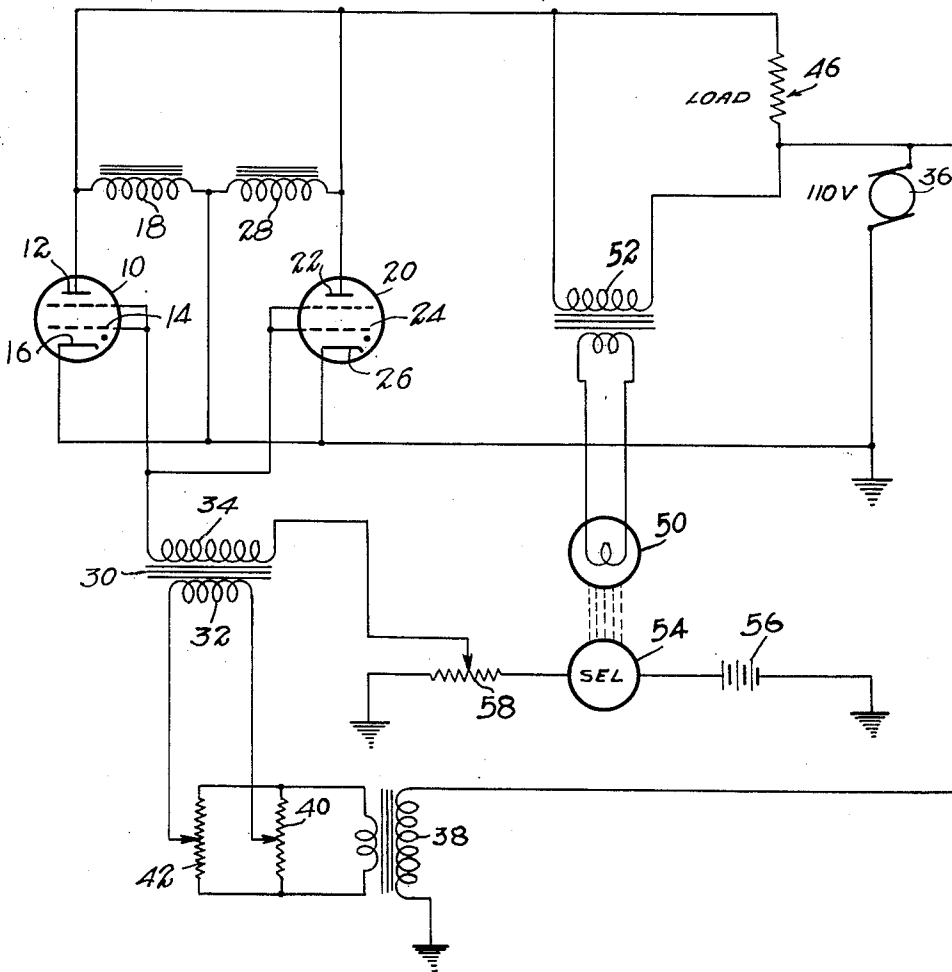
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VOLTAGE-REGULATING SYSTEM

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VOLTAGE-REGULATING SYSTEM

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2 Claims. (Cl. 323—21)

This invention relates to voltage-regulating systems and, more particularly, to improvements therein.

A feature of the present invention is the provision of a system for regulating alternating current voltages.

Another feature of this invention is the provision of a novel and useful regulating system.

Still another feature of the present invention is the provision of a regulating system which can be employed for regulating voltages over an extensive range of load currents.

These and other features of the invention are provided in a system wherein each of two gas tubes has a saturable reactor control winding connected between its anode and its cathode. The tubes are biased by an alternating-current priming bias which positions them at conduction. A load may be connected to the anodes of the gas tubes. Alternating-current operating potential is applied between the cathodes and through the load to the anodes of the two gas tubes. Voltage-control means consisting of an electric light is coupled across the load in a manner so that variations in the voltage being supplied to the load cause fluctuations in the intensity of the light. A photocell or phototube is positioned to receive light from the electric light. Its output is a voltage which varies with the intensity of the light. This photocell output is applied to the control grids of the two tubes as a bias which opposes the previously described priming bias. This additional bias causes the gas tubes to conduct in a manner so that the voltage which is applied across the load is maintained substantially constant. In effect, what is provided here is a means of obtaining regulation, in which fluctuations either caused by variations in the load or even due to some variations in source of supply are minimized.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawing, which is a circuit diagram of the embodiment of the invention.

Referring now to the figure, there may be seen a pair of gas tubes 10, 20. These are preferably of the grid-controlled type such as a thyatron, having an anode 12, 22, a control grid 14, 24, and a cathode 16, 26. A saturable reactor 18, 28 is connected by means of its control winding between the anode and cathode of each tube. A priming bias is provided to both tubes, to render them conducting, from a transformer 30, which has primary winding 32 and a secondary winding 34. An A. C. voltage is applied to the primary of the transformer from a source 36 which is connected through a stepdown transformer 38 to two potentiometers 40, 42. These potentiometers are connected in the manner of a resistance bridge and have their sliders connected to the primary of the transformer 30. The transformer secondary is connected to both the control grids 14, 24

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of the gas tubes. A load 46 is connected to the anodes of both gas tubes. Operating potential for the tubes is connected from the source 36 to the load and to the cathodes of the gas tubes.

As thus far described, the circuit essentially resembles the one shown, described, and claimed in an application for a Control System by this inventor bearing Serial Number 420,349 and filed April 1, 1954. The operation of the system shown thus far is substantially as described in the application, namely, the gas tubes, when biased to conduct, have their impedances reduced considerably. The saturable reactors each has a high impedance when no D. C. is passing through its control winding. When the gas tube conducts, a certain amount of D. C. circulates between it and the control winding of the saturable reactor connected thereacross, thus reducing the impedance of the reactor. Thus, the current which passes through both tube and saturable reactor is considerably greater, due to the two low-load impedances in parallel, than would pass either through the tube alone or the saturable reactor alone. When the gas tube is not conducting, its impedance is high and, in view of the fact that no D. C. flows through the saturable-reactor winding at that time, its impedance is also high. Thus the circuit can control a considerably larger current flow with these connections than by using either the tubes alone or the saturable reactors alone. A detailed description of the operation of the control system may be found in the previously mentioned application. Therein also there is shown how a regulatory operation of a servo type is made possible when the load consists of the field windings of a motor and the shaft of the motor is coupled to one of the potentiometers 42, 40 in a manner to restore the balance of the bridge when an unbalance occurs.

The regulatory operation in the present embodiment of the invention is provided by means of an electric light 50, which is coupled across the load by means of a stepdown transformer 52. A photocell 54, which may alternatively be a phototube if amplification is desired, receives light from the electric light 50. The photocell is biased by means of battery 56 and control resistor 58 in a well-known manner. Accordingly, light variations cause the current flowing through the photocell to vary in accordance therewith. Since the photocell is also connected to the secondary winding 34, the variations of bias are communicated to the grids of the gas tubes where, in combination with the priming bias, they control the current flow through the gas tubes. The bias supplied from the photocell is applied with a polarity to increase the flow of current when there is a decrease in the light output. Thus the photocell bias opposes the priming bias. The effect of the light and photocell feedback regulation is to increase considerably the sensitivity of the voltage control arrangement while providing an inexpensive feedback system. The light employed was a standard commercially obtainable light source for which the stepdown transformer reduced the applied voltage to the region of one-half its rated operating voltage. This portion of the light source characteristic displays excellent linearity with variations in the fluctuations of the voltage applied to the primary of the transformer 52, while the thermal inertia of the filament is not affected by the powerline frequency fluctuations. The system was operated at both 60-cycle and 400-cycle frequencies and displayed excellent regulatory characteristics. The range of control is fairly extensive and may be adjusted for different values of output voltage from the anodes of the gas tubes by adjusting the output voltage of transformer 52 to maintain the voltage applied across the electric light 50 within the region wherein its character is substantially linear with voltage variations. While two gas and two saturable reactors are shown

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and described herein, it will be appreciated that it is within the scope of this invention to use one tube and one saturable reactor, two tubes and one saturable reactor, or any combination of different numbers of tubes and saturable reactors to achieve the required regulation of voltage and current.

Accordingly, there has been described and shown herein a novel, simple, and useful system for controlling the output voltage from an alternating-current source.

I claim:

1. A voltage-control system comprising a pair of tubes each having anode, cathode, and control electrodes, a pair of saturable reactors, each of which is connected between anode and cathode of a different one of said tubes, means to apply a load to said anodes, means to apply an operating potential between said anodes and cathodes, an electric light, means to couple said electric light to produce fluctuation of said light output with variations in potential at said means to apply a load, photocell means to generate a regulatory bias responsive to said fluctuations of said light, means to apply a priming bias to said control grids including a transformer having a primary winding and a secondary winding, said control grids being respectively coupled to one end of said secondary winding, and means to apply said regulatory bias to said con-

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trol grids including connections between said photocell means and said secondary winding to control said tubes to compensate for said potential variations.

2. In a voltage-control system of the type including a pair of gas tubes each having a control grid, an anode, and a cathode, each having a saturable reactor connected between said anode and cathode, a transformer having a secondary winding, said control grids being coupled to said secondary winding, means to apply a priming bias to the primary winding of said transformer, and means to apply operating potential to said gas tubes, the improvement comprising apparatus to regulate the voltage output of said gas tubes including an electric light, a transformer coupling said electric light to said anodes to derive illuminating current therefrom, photocell means exposed to said light to generate a regulatory bias varying responsive to variations in illumination, and means to apply said regulatory bias to said secondary winding to control said gas tubes to substantially eliminate said variations in illuminating current.

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