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VOLTAGE STABILIZING APPARATUS

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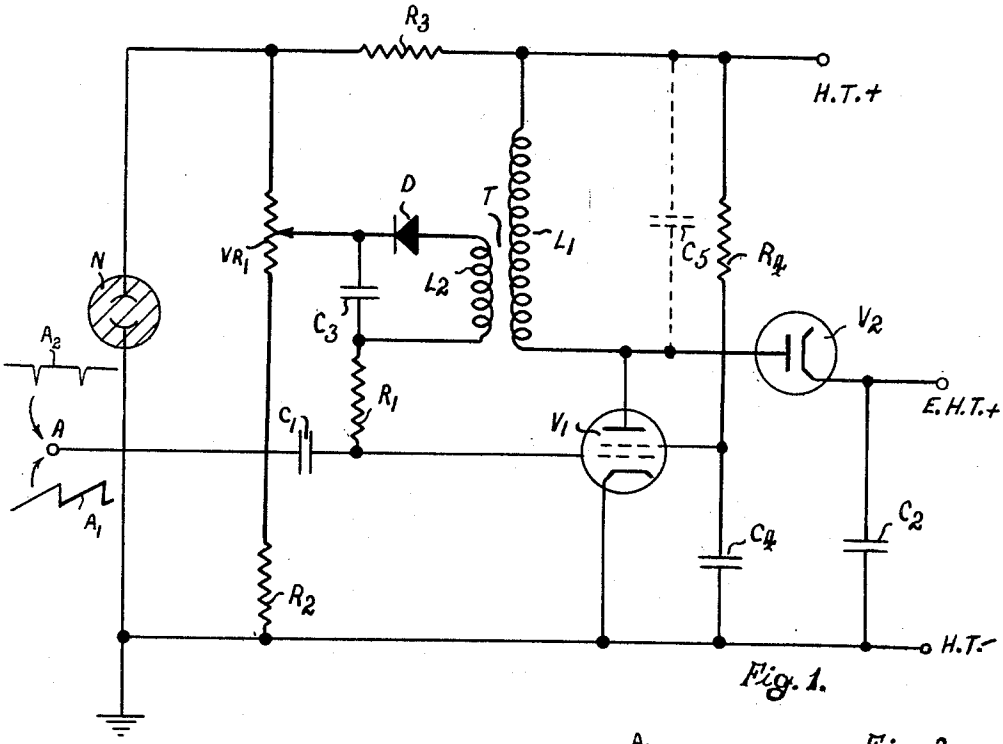


Fig. 1.

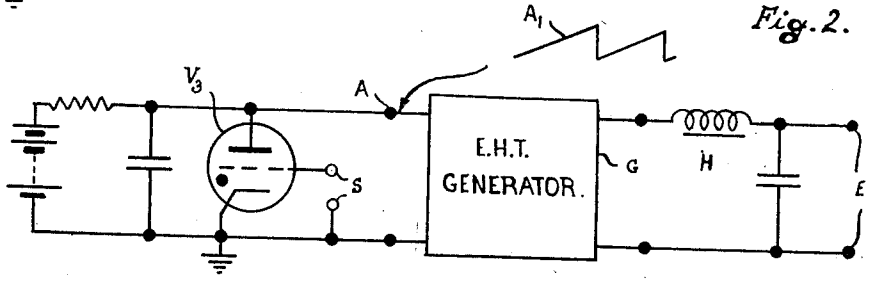


Fig. 2.

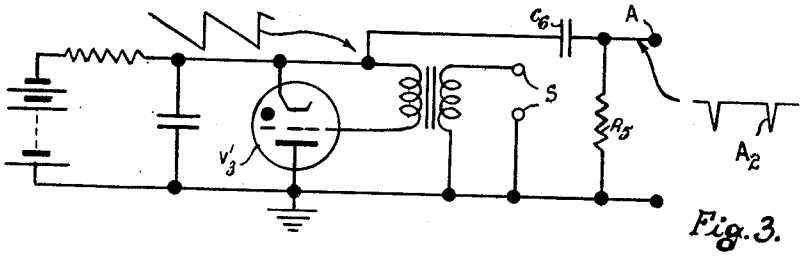


Fig. 3.

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VOLTAGE STABILIZING APPARATUS

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5 Claims. (Cl. 321—2)

1

This invention relates to apparatus for producing a unidirectional high potential the value of which is automatically stabilized so as to be largely independent of fluctuations in load.

When the apparatus used for this purpose makes use of a voltage step-up transformer having alternating current applied to its primary winding in combination with a rectifier associated with the secondary winding of the transformer, and when the apparatus operates at the normal power supply frequency, the insulation needed and the other precautions which must be taken result in the cost of such apparatus being relatively high. Moreover it is not easy with such apparatus to arrange that the magnitude of the output potential is variable.

This invention is concerned with alternative apparatus, which is in general less costly than that referred to, of the type comprising an electron discharge valve having an inductance in its anode-cathode circuit, terminals for connecting the anode to the positive terminal and the cathode to the negative terminal of a suitable source of potential, means for applying to a control grid of the valve a potential of steep-sided waveform to generate voltage pulses of high potential across the inductance, and means for rectifying the voltage pulses to produce the required high potential.

Apparatus of this type may be used for the production of so-called extra high tension operating potentials of different magnitudes in many circumstances in which a comparatively stable source is needed, such for example as for laboratory work, and also for a cathode ray tube in say a television receiver. Apparatus of the type specified may be operated from voltages of a variety of different waveforms. When the apparatus is for use in television receivers the operating waveform is conveniently one of sawtooth waveform derived from the line time base. Small changes in the output load of the circuit, consisting principally of variations in beam current of the cathode ray tube, have been found to produce noticeable changes in the magnitude of the high potential. The magnitude of the beam current determines the brilliance of the scanning spot producing the display on the screen of the cathode ray tube and the resulting change in magnitude of the high potential may be sufficient to alter both the focus and the beam deflection sensitivity. This mutual interdependence of brilliance, focus and beam deflection on sensitivity is often a serious disadvantage. Variations in the high potential may also be caused by variations in the bias voltage upon the control grid of

2

the said valve as well as by variations of the anode-cathode voltage thereof.

One object of this invention is to provide apparatus of the type set forth in which the stability of the said high potential is improved.

A further object of the invention is to provide apparatus of the type set forth in which it can readily be arranged that the magnitude of the high potential is variable.

According to this invention, in apparatus of the type specified means are provided to derive a unidirectional controlling potential of magnitude dependent upon that of the high potential and to apply this potential to the control grid circuit of the valve in such sense as to reduce variations in the high potential.

According to a feature of the invention, adjusting means are provided for varying a standing bias voltage upon the control grid of the said valve to permit variation in the magnitude of the high potential. According to a further feature of the invention, the said standing bias voltage is furnished by a voltage source subject to variation and a neon or other stabilizer is provided to improve the constancy of the standing bias voltage at each setting of the said adjusting means.

The invention will now be described by way of example with reference to the accompanying drawing which shows in Figure 1 the circuit diagram of an extra high tension generator according to the invention, Figure 2 shows how a sawtooth voltage may be applied to the circuit of Figure 1 and how the output from Figure 1 may be smoothed and Figure 3 how pulses may be generated from a line time base circuit for application to the circuit of Figure 1.

Referring first to Figure 1, the circuit shown is suitable for developing a direct extra high tension voltage of about 8 kv., in which V_1 is a tetrode valve of the type "Cossor 185 BT". It is to be understood, however, that other types of valve including triodes and pentodes may be employed, one requirement being that the anode and its lead-in are sufficiently insulated from other electrodes and their respective leads-in. A transformer T is connected in the anode circuit of valve V_1 and may be one having an air core and a primary to secondary turns ratio of about 65, but if desired an alternative design utilising a ferro-magnetic core may be employed instead. The anode of the valve V_1 is connected through the primary winding of the transformer to the positive terminal H. T.+ of a suitable voltage source, the negative terminal H. T.— of

which is connected to the cathode and earth. The input voltage is applied at a terminal A and may consist of a sawtooth oscillation, such as is used for scanning in television, applied in such sense that the return strokes are negative-going as indicated at A_1, or a train of short negative-going pulses as indicated at A_2 derived from the line time base (not shown). This voltage is fed to the control grid of the valve V_1 through a condenser C_1 having a capacitance of, say, 5000 micro-micro-farads. In normal operation the control grid is arranged to be biased relatively to the cathode in such a way that the positive peaks of input voltage do not reach the region of grid current while the negative peaks extend well beyond anode-cathode current cut-off. By the use of the return strokes of the saw-tooth wave or sharp pulses to cut off the valve V_1, the recurrent change from a conducting state to a non-conducting state of the valve is arranged to be very rapid and the natural frequency of the resonant circuit constituted by the inductance L_1 and the stray capacitance C_5 in parallel therewith is arranged to be considerably higher than the frequency of the oscillations applied to terminal A. Under these conditions, and assuming that the current in the valve V_1 is arranged to be cut off soon after this current has passed its maximum value, the peak value of the voltage between the anode and cathode of the valve V_1 is dependent to a large extent upon the energy stored in the inductance L_1 immediately prior to the cut-off. This energy is, in turn, dependent upon the value of the current flowing in the inductance L_1 immediately prior to cut-off. For any given valve V_1 the value of the latter current is dependent upon the shape of the input waveform applied at A, the amplitude of this input and the standing bias between the control grid and cathode of the valve V_1.

The result of each cut-off in the valve V_1 is thus to cause the circuit L_1C_5 to ring and produce a surge of high potential at the anode of the valve. These surges may be suitably rectified by a diode valve V_2, for example of type "Cossor SU25," connected in series with a condenser C_2 between the anode of the valve V_1 and earth H. T.—, the anode of the diode V_2 being connected to the anode of the valve V_1. The unsmoothed direct extra high tension voltage is made available across the condenser C_2, that is between terminals E. H. T.+ and earth.

It will be appreciated that a similar sequence of voltage surges of smaller amplitude, 120 volts for example, appears across the secondary of the transformer T. These surges are rectified by the rectifier D, which may be of the cold metal-rectifier type and need only pass a few milliamps of current, connected in series with condenser C_3 across the secondary winding. The D. C. component appearing across C_3 is applied through a grid leak R_1 of say 22,000 ohms to bias the control grid of the valve V_1 more negatively when the peak anode voltage of the valve V_1 increases. The junction of the rectifier D and condenser C_3 is connected to a suitable source of positive voltage. In the example shown the source comprises a potentiometer VR_1 in series with a fixed resistor R_2, the combination in parallel with a neon stabiliser N being connected through a fixed resistor R_3 between the source terminals H. T.+ and H. T.—. The stabiliser N provides a substantially constant bias voltage on the control grid of the valve V_1 in spite of changes in the source voltage. The tapping of

potentiometer VR_1 is connected to the terminal of the condenser C_3 which becomes charged positively; its setting determines the constant component of the bias supplied to the control grid of the valve V_1 and adjustment of the tapping permits adjustment of the magnitude of the extra high tension voltage.

The screen grid of V_1 is fed from the terminal H. T.+ through a fixed resistor R_4 and is decoupled by a condenser C_4 whose impedance at the relevant frequencies is negligible.

It will be appreciated that when the embodiment described is in operation variations in voltage across the primary of transformer T due to any cause will involve corresponding variations in the secondary voltage and hence in the bias supplied to the valve V_1 over the grid leak R_1. The component of this bias voltage which arises from an increase or decrease in the voltage at the anode of the valve V_1 may be made large compared with the grid voltage required to produce such an increase or decrease and hence small changes in the voltage at the anode may be caused to bring about correspondingly large changes in the amplitude of the anode current just before the rapid collapse. The variable component of bias is applied to the control grid in such sense that an increase in extra high tension voltage results in an increase in negative bias and a decrease in the magnitude of the anode current before its collapse. Similarly a decrease in extra high tension voltage results in a decrease in the negative bias applied to the control grid, and hence in an increase in the magnitude of the anode current through the primary of transformer T before its collapse. It is thus seen that the bias acts always in such a sense as to tend to return the extra high tension voltage to a constant value. A high degree of stability against changes in extra high tension load, input waveform, and H. T supply voltage may thus be achieved by this comparatively simple device. The value at which the extra high tension voltage is stabilised in readily determined by the constant component of bias which, in turn, may be made dependent only on the setting of the potentiometer VR_1, which may therefore be used as a simple extra high tension voltage adjustment control.

In Figure 2 there is shown a well known form of sawtooth generator comprising a valve V_3 which may be either a hard valve or as shown a gas-filled valve. Synchronising pulses are applied at terminals S. The extra high tension generator of Figure 1 is indicated by a rectangle G. A smoothing circuit is shown diagrammatically at H and the smoothed output is taken from terminals E.

In Figure 3 the sawtooth generator of Figure 2 is shown inverted, the valve being represented at V_3', in order to generate a sawtooth wave in which the return strokes are positive-going. A differentiating circuit C_6R_5 generates the negative-going pulses A_2 for application to the terminal A in Figure 1.

I claim:

1. Apparatus for producing a stabilized, unidirectional high potential comprising an electron discharge valve, means to bias said valve to be normally conducting between anode and cathode, an inductor in the anode-cathode circuit of said valve, a source of exciting potential comprising a generator of oscillations of sawtooth waveform having a relatively slow working stroke and a relatively rapid return stroke,

means to apply said exciting potential to the control grid of said valve to render said valve non-conducting and thereby generate voltage across said inductor and at said anode, means to rectify said voltage pulses to derive a unidirectional controlling potential of magnitude varying in dependence on the variations in amplitude of said pulses at said anode and of opposite sense to the variations at said anode and means to apply said controlling potential to said control grid to reduce variations in the amplitude of said pulses.

2. Apparatus for producing a stabilised, unidirectional high potential comprising an electron discharge valve, means to bias said valve to be normally conducting between anode and cathode, an inductor in the anode-cathode circuit of said valve, a source of exciting potential of steep-sided waveform, means to apply said exciting potential to the control grid of said valve to render said valve non-conducting and thereby generate voltage pulses across said inductor, means to rectify said voltage pulses to derive a unidirectional controlling potential of magnitude varying in dependence on the variations in amplitude of said pulses at said anode and of opposite sense to the variations at said anode, means to apply said controlling potential to said control grid, means to rectify said pulses to produce said unidirectional high potential, means to apply a standing bias voltage to said control grid relatively to said cathode, and means to vary said pulses and hence of said bias voltage to vary the magnitude of said high potential.

3. Apparatus for producing a stabilised, unidirectional high potential comprising an electron discharge valve, an inductor in the anode-cathode circuit of said valve, a source of exciting potential of steep-sided waveform, means to apply said exciting potential to the control grid of said valve to render said valve non-conducting and thereby generate voltage pulses across said inductor and at said anode, means to rectify said voltage pulses to produce said unidirectional high potential, a source of standing bias voltage subject to variation, a stabilising device to improve the constancy of said bias voltage, means for applying said bias voltage between the control grid and cathode of said valve, means for varying the magnitude of said bias voltage to vary the magnitude of said high potential, means to derive a unidirectional controlling potential of magnitude varying in dependence upon variations in the amplitude of said pulses at said anode and of a sense opposite to that of the variations at said anode and means to apply said controlling potential to said control grid to reduce variations in the amplitude of said pulses.

4. Apparatus for producing a stabilized unidirectional high potential comprising an electron discharge valve, means to bias said valve to be normally conducting between anode and cathode, inductor means providing substantial inductive reactance in the plate current path of said valve, a rectifier coupled between the anode and cathode of said valve, a source of unidirectional potential, means to connect one terminal of said rectifier to said source, means to connect the other terminal of said rectifier to the control grid of said valve, a source potential of recurrent steep-sided waveform, means to apply potential from said source to render said valve recurrently non-conducting and thereby to generate a high voltage at said anode, and means to rectify said high voltage to produce said unidirectional high potential.

5. Apparatus for producing a stabilised, unidirectional high potential comprising an electron discharge valve, means to bias said valve to be normally conducting between anode and cathode, an inductor in the anode-cathode circuit of said valve, a source of exciting potential comprising a generator of pulses having a duration short compared with their recurrence period, means to apply said exciting potential to the control grid of said valve to render said valve non-conducting and thereby generate voltage across said inductor and at said anode, means to rectify said voltage pulses to derive a unidirectional controlling potential of magnitude varying in dependence on the variations in amplitude of said pulses at said anode and of opposite sense to the variations at said anode and means to apply said controlling potential to said control grid to reduce variations in the amplitude of said pulses.

DENNIS HENRY COVILL.

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