

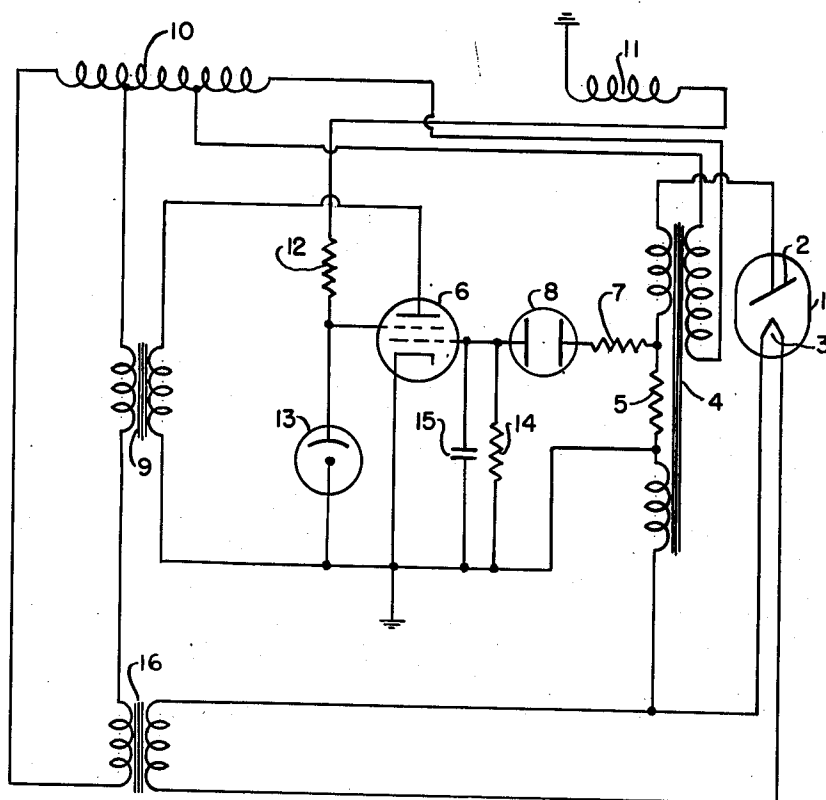
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TUBE CURRENT STABILIZER

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TUBE CURRENT STABILIZER

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My invention relates to a device for stabilizing the current flowing through an X-ray tube.

It is an object of my invention to provide a current stabilizer for an X-ray tube which is independent of supply voltages.

It is a further object of my invention to provide a current stabilizer which is inherently sensitive to small changes in tube current in an X-ray tube.

It is a still further object of my invention to provide a current stabilizer which is relatively simple to construct.

These and further objects of my invention will appear as the specification progresses.

According to my invention, the tube current of an X-ray tube is stabilized by controlling an impedance in the filament supply circuit for the tube. This is accomplished by deriving a potential which is proportional to the tube current and applying this potential to a control electrode of a multi-element thermionic discharge tube, the output of which reflects an impedance proportional to the potential applied to the control electrode. This output impedance is thereupon reflected into the filament supply circuit of the X-ray tube so that a change of anode current is reflected as a change in impedance in the filament supply circuit.

In order that the invention can be more clearly understood and carried into effect, it will now be described in connection with the appended drawing in which the single figure shows a current stabilizer for an X-ray tube in accordance with the invention.

An X-ray tube 1 provided with an anode 2 and a filamentary cathode 3 is supplied with high tension excitation through a high tension transformer 4 having a split secondary winding. Between the two sections of the secondary winding a resistor 5 develops a potential proportional to the tube current which potential is applied to the control electrode of a multi-element thermionic discharge tube 6 through a resistor 7 and a glow discharge lamp 8. While I prefer to use a beam tetrode of the 6L6 type, any multi-element tube having a substantially constant plate impedance may be employed such as the conventional pentode tube.

The output of tube 6 is coupled through a plate supply transformer 9 to a potential source 10 such as an auto transformer connected to the power supply and provided with connections for supply voltage to the high tension transformer 4 and the filament supply transformer 16. The secondary winding of transformer 9 is connected

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in series with the primary winding of transformer 16 so that a change in the output impedance of tube 6 is reflected as a change in impedance in the filament supply circuit.

The screen electrode of tube 6 is supplied through a separate transformer winding 11 from a power source through a screen supply resistor 12 and a voltage regulator type tube 13 which maintains the screen voltage independent of supply voltage fluctuations.

To understand the operation of the stabilizer, it is assumed that the X-ray tube is connected in the circuit of the high tension supply and is energized. An anode current flowing through tube 1 causes a potential drop across resistor 5 which biases 6 at some point on its characteristic curve. Tube 6, which is energized by an A.-C. potential through transformer 9 reflects a given impedance into the output circuit of transformer 9 and thence into the filament supply circuit of the X-ray tube. If the anode current changes due to changes in supply voltage or localized heating of the filament, a corresponding potential change occurs across resistor 5 thus altering the bias on tube 6. As a result of a change in tube bias, tube 6 changes its output impedance which is reflected into the filament supply circuit thus controlling the heating current for the filament. Thus, an increase in tube current is reflected as an increased impedance of the tube which in turn is reflected as an increase in impedance in the filament supply circuit.

In order to increase the sensitivity of the stabilizer, a filter consisting of a resistor 14 and a capacitor 15 shunt the control electrode to the cathode of the tube between the glow discharge tube 8 and the control electrode. Resistor 14 and glow discharge tube 8 form a potentiometer in which the glow discharge tube represents a non-linear resistance. At the breakdown voltage of the glow-discharge tube it conducts and at higher voltages, the tube has a constant potential drop. Hence, voltage difference between the voltage available across resistor 5 and the tube breakdown voltage appears across resistor 14 which now serves as a voltage amplifier.

Further, since tube 1 is of the self-rectifying type, current flows only during alternate half cycles through the tube causing voltage pulses to appear across resistor 5. With capacitor 15 charged during the voltage pulse, the capacitor slowly discharges through resistor 14 during that portion of the cycle when tube 1 is non-con-

ducting thus providing substantially constant bias on the control electrode of tube 6.

While I have thus described my invention with a specific example and a specific application other obvious modifications will be readily apparent to those skilled in the art without departing from the spirit and scope of my invention.

What I claim is:

1. A current stabilizer for an X-ray tube having a cathode and an anode comprising a thermionic discharge device including a cathode, an anode and a control electrode, a cathode-anode supply circuit for said X-ray tube, means coupled to the cathode-anode circuit of the X-ray tube for deriving a control potential proportional to the current flowing therein, means to apply said control potential to the control electrode of the thermionic discharge device to vary the internal resistance thereof accordingly, an alternating current supply circuit for the cathode of said X-ray tube, an impedance interposed in the said supply circuit, and means coupling the cathode and anode of the thermionic discharge device in shunt relation with said impedance to derive an alternating-current voltage for energizing the said thermionic discharge device whereby the internal resistance of the said thermionic discharge device is reflected into said supply circuit.

2. A current stabilizer for an X-ray tube having a cathode and an anode comprising a thermionic discharge device including a cathode, an anode and a control electrode, a cathode-anode supply circuit for said X-ray tube, an impedance in the cathode-anode circuit of the X-ray tube for deriving a control potential proportional to the current flowing therein, means to apply the said control potential to the control electrode of the thermionic discharge device to vary the internal resistance accordingly, an alternating current supply circuit for the cathode of said X-ray tube, a transformer having intercoupled windings one of which is interposed in the supply circuit, and means coupling the cathode and anode of the discharge device in shunt relation with another of the windings of said transformer to derive an alternating-current voltage for energizing the said thermionic discharge device whereby the internal resistance of the said thermionic discharge device is reflected into said supply circuit.

3. A current stabilizer for an X-ray tube having a cathode and an anode comprising a thermionic discharge device including a cathode, an

anode and a control electrode, an alternating-current cathode-anode supply circuit for said X-ray tube, an impedance in the cathode-anode circuit of the X-ray tube for deriving unidirectional voltage pulses proportional to the current flowing therein, means to derive a control potential from said voltage pulses, means to apply the control potential to the control electrode of the thermionic discharge device, an alternating current supply circuit for the cathode of the X-ray tube, a transformer having intercoupled windings one of which is interposed in the supply circuit, and means coupling the cathode and anode of the discharge device in shunt relation with another of the windings of said transformer to derive an alternating-current voltage for energizing the said thermionic discharge device whereby the internal resistance of the said thermionic discharge device is reflected into said supply circuit.

4. A current stabilizer for an X-ray tube having a cathode and an anode comprising a thermionic discharge device including a cathode, an anode and a control electrode, an alternating-current cathode-anode supply circuit for said X-ray tube, an impedance in the cathode-anode circuit of the X-ray tube for deriving unidirectional voltage pulses proportional to the current flowing therein, means to derive a control potential from said voltage pulses comprising a pulse filter network including a threshold limiter, means to apply the control potential to the control electrode of the thermionic discharge device, an alternating current supply circuit for the cathode of said X-ray tube, a transformer having intercoupled windings one of which is interposed in the supply circuit, and means coupling the cathode and anode of the discharge device in shunt relation with another of said windings to derive an alternating-current voltage for energizing the discharge device whereby the internal resistance of the discharge device is reflected into said supply circuit.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,319,378	Weisglass	May 18, 1943
2,512,193	Zavales	June 20, 1950