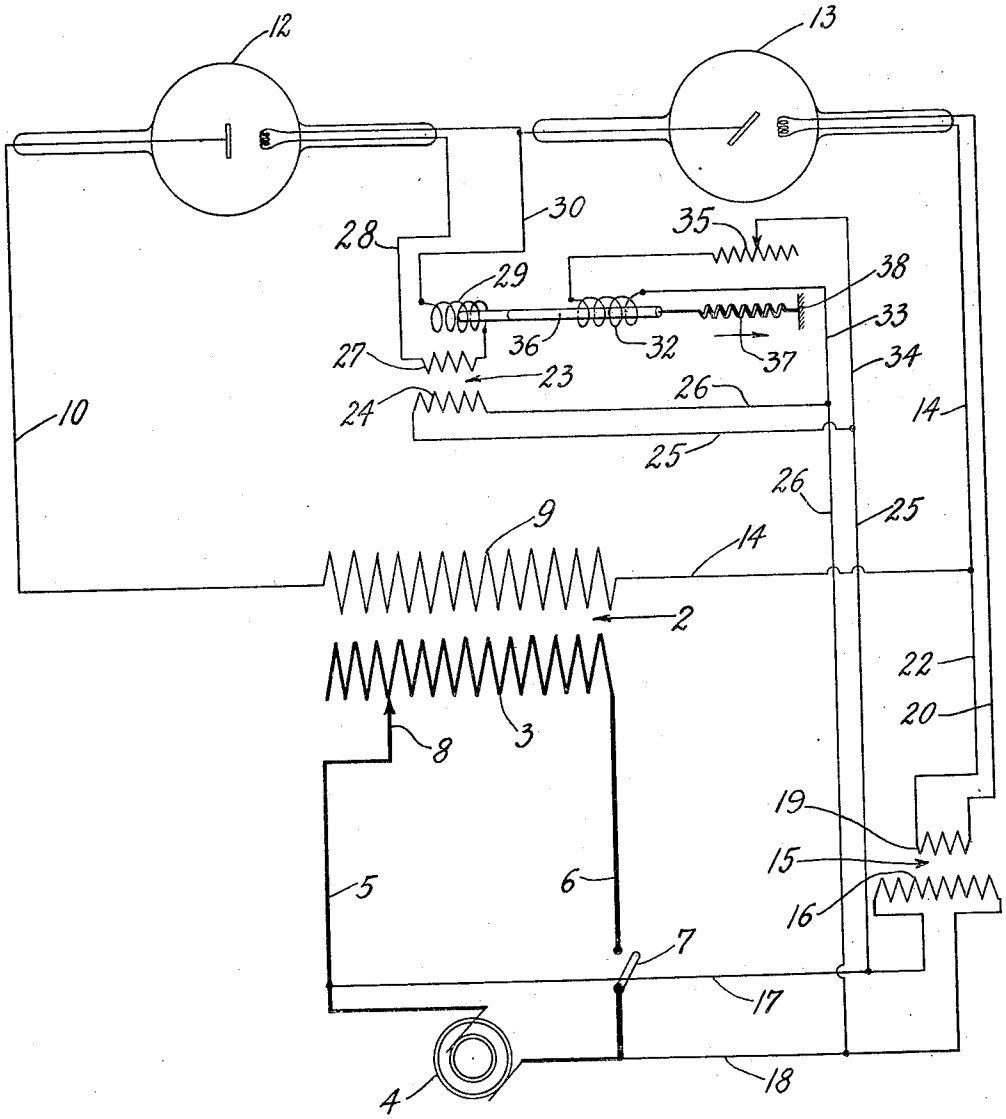
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DISCHARGE TUBE STABILIZER SYSTEM

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Inventor:
MONTFORD MORRISON
BY M. J. Rego
ATTORNEY

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MONTFORD MORRISON, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO WESTINGHOUSE X-RAY COMPANY, INC., A CORPORATION OF DELAWARE

DISCHARGE TUBE STABILIZER SYSTEM

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My invention relates to a stabilizer system for vacuum valve tubes of the thermionic cathode type such as X-ray and rectifier tubes.

The operation of tubes of this type is dependent upon the discharge of thermionic currents from a cathode heated to incandescence together with the potential supplied between the electrodes of the tube. Electrical energy for heating the cathode is generally supplied from a low-tension transformer while a main high-tension transformer is usually employed to supply the requisite high voltages between the electrodes of the tube.

In order to maintain the electron emission from the heated cathode at a constant value it is imperative to maintain the temperature of the cathode as nearly constant as possible as any variation of temperature causes a like variation in electron emission. As the high and low-tension transformers are usually energized from a common source of alternating commercial potential the X-ray tube is, therefore, subjected to line fluctuations common to all sources of commercial potential. These line fluctuations cause a variation in the temperature of the heated cathode with a resulting increase or decrease in electron emission and necessarily an unstable and undesirable operation of the X-ray or rectifier tube.

By my invention I seek to render the discharge current of the discharge tube constant, independent of any variations in voltage of the high tension transformer, by the provision of a structure which is electrically responsive to line fluctuations for maintaining the temperature of the cathode constant and therefore the discharge current of the tube constant.

Another object of my invention is to make my electro-responsive structure adjustable in such a manner that the degree of control exerted by line fluctuations may be varied within certain limits.

Still further objects of my invention will become apparent to those skilled in the art by reference to the accompanying drawing wherein the single figure is a diagrammatical view of an X-ray circuit employing an X-ray tube and a rectifier tube with which my device may be utilized.

Referring now to the single figure in detail I have shown a high-tension transformer 2 for supplying high voltages, the primary winding 3 of which receives electrical energy from a source of commercial alternating potential such as a generator 4. A pair of conductors 5 and 6 connect the generator 4 to the primary winding 3 and a suitable switch 7 is provided in one of these conductors 6 for connecting and disconnecting the primary winding 3 from the source 4. The primary winding 3 is provided with a movable contact arm 8 to which one of the supply conductors 5 is connected for varying the energy supplied to the transformer 2 in a well known manner.

The secondary winding 9 of the high-tension transformer 2 has one end connected, by means of a conductor 10 to the anode of a discharge tube 12, herein utilized for rectifying the currents supplied to an X-ray tube 13. The other end of this secondary winding 9 is connected, by means of a conductor 14, to the filamentary cathode of the X-ray tube 13. A low-tension transformer 15 is provided for supplying heating current and is arranged to have its primary winding 16 energized, by means of conductors 17 and 18 from the source 4.

One end of the secondary winding 19 of the low-tension transformer 15 is connected, by means of a conductor 20, to the filamentary cathode of the X-ray tube 13 and the other end of this secondary winding 19 is connected by means of a conductor 22, to the conductor 14.

A low-tension transformer 23 is also provided for supplying heating current for the filamentary cathode of the discharge tube 12. The primary winding 24 of this latter transformer likewise receives energy from the source 4, by means of conductors 25 and 26. One end of the secondary winding 27 of this low-tension transformer 23 is connected by means of a conductor 28 to the filamentary cathode of the discharge tube 12. The other end of this secondary winding is connected to a reactance 29 and a conductor 30 connects this reactance with the filamentary cathode

of the discharge tube 12 and the anode of the X-ray tube 13.

A reactance 32 is connected, by means of conductors 33 and 34 to the conductors 25 and 26, and is therefore energized from the common supply source 4. A variable resistance 35 is connected in series with this latter reactance for a purpose to be hereinafter more fully described. A magnetic core 36 is arranged to pass through the windings of the reactances 29 and 32 and a coil spring 37 is secured to one end of this core 36 and to a fixed portion 38 of the apparatus.

The operation of my device may be described as follows: a suitable switch (not shown) is closed permitting current to flow from the source 4 to the primary windings 16 and 24 of the respective low-tension transformers 15 and 23. Current will then flow from the secondary winding 19, through conductors 20 and 22 and heat the filamentary cathode of the X-ray tube 13.

In the same manner current will flow from the secondary winding 27 through conductor 28, reactance 29 and conductor 30 and heat the filamentary cathode of the discharge tube 12.

The switch 7 is then closed allowing the primary winding 3 of the high-tension transformer 2 to become energized. The movable contact arm 8 is then adjusted to give the desired potential and energy will then flow from the secondary winding 9, through conductor 14, X-ray tube 13, discharge tube 12 and thence by means of conductor 10 back to the secondary winding 9 during each half wave of the alternating current cycle.

The current in flowing to the filamentary cathode of the discharge tube 12, through the reactance 29, tends to draw the core 36 against the tension of the spring 37. The current in flowing from the source 4 through the reactance 32 likewise tends to move the core 36 inward of the reactance 29. As the current and potential from the source 4 fluctuates the currents flowing through the reactances 29 and 32 likewise vary. When a drop in potential occurs from the source 4 with an increase in current, an increase in current likewise occurs in the reactances 29 and 32. This causes a movement of the core 36 inwardly of the reactance 29 or to the left as shown in the figure, and enables the reactance 29 to act as a choke coil thus increasing the impedance of the circuit from the secondary winding 27, through the reactance 29, and the filament of the discharge tube 12. By increasing the impedance of this circuit it naturally follows that a decrease in current occurs in the same circuit.

In the same manner when an increase in potential and a decrease of current occurs from the source 4 a decrease in current follows in the reactances 29 and 32. When this decrease occurs the coil spring 37 withdraws the core from the reactance coil 29 thus decreasing the impedance of the filament circuit and increasing the current flowing therethrough. This action continues as long as fluctuations of voltage and current from the source continue which, due to the action of the reactances 29 and 32, maintains the current supplied to the filament of the discharge tube at a constant temperature which enables the electron emission to remain constant regardless of fluctuations in potential between the electrodes of the tube. The variable resistance 35 is provided in the circuit to the reactance 32 for the purpose of varying the degree of control exerted by the fluctuations in the source by increasing or decreasing the range of fluctuations. By increasing the resistance the degree of control is limited as well as the range of potential and current fluctuations from the source, while the converse condition follows upon a decrease in the resistance 37.

Although in this particular embodiment of my invention I have shown my device utilized for the purpose of maintaining the discharge current of the rectifier tube constant it is obvious that due to the series connection of the rectifier and X-ray tubes, the discharge current of the X-ray tube will likewise be maintained constant. If desirable, however, my device may just as readily be inserted in the filament heating circuit of the X-ray tube and where two rectifier tubes are employed for full wave rectification my device may be employed in the filament heating circuit of each rectifier tube or the X ray.

It can therefore be readily seen that I have provided a stabilizer for a discharge tube, in which the operation is dependent upon the discharge of thermionic currents from a heated cathode, that maintains the temperature of the cathode constant by maintaining the current supplied to the cathode constant, regardless of the fluctuations in potential and current from the source of supply or of high-tension variations between the electrodes of the tube.

Although I have shown and described one specific embodiment of my invention I do not desire to be limited thereto as various other modifications of the same may be made without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In an electron discharge apparatus, an electron discharge tube having main electrodes, one of which is a thermionic cathode, a high-tension transformer for supplying energy to said electrodes, a low-tension transformer for supplying heating current to said cathode, a reactance in series with said low-tension transformer and said cathode, a source of energy subject to current variations common to both of said transformers for en-

ergizing the same, a reactance varying with current variations in said source and associated with said first mentioned reactance for varying the current supplied to said cathode in accordance with variations in said source.

2. In an electron discharge apparatus, an electron discharge tube having main electrodes, one of which is a thermionic cathode, a high-tension transformer for supplying energy to said electrodes, a low-tension transformer for supplying heating current to said cathode, a reactance in series with said low-tension transformer and said cathode, a source of energy subject to current variations common to both of said transformers for energizing the same, a reactance varying with current variations in said source and mechanically associated with said first mentioned reactance for increasing the current supplied to said cathode upon a decrease of current in said source and decreasing the current supplied to said cathode upon an increase of current in said source.

3. In an electron discharge apparatus, an electron discharge tube having main electrodes, one of which is a thermionic cathode, a high-tension transformer for supplying energy to said electrodes, a low-tension transformer for supplying heating current to said cathode, a reactance in series with said low-tension transformer and said cathode, a source of energy subject to current variations common to both said transformers for energizing the same, a reactance varying with current variations in said source and provided with a magnetic core associated with said first mentioned reactance for varying the current supplied to said cathode in accordance with variations in said source.

4. An electric discharge system comprising a thermionic discharge tube provided with a hot cathode, a power supply circuit therefor subject to variations, a high-tension transformer having its primary winding in said supply circuit, a heating circuit for the cathode of said tube, a low-tension transformer for supplying heating current for said heating circuit and having its primary winding in said supply circuit, a reactance in said heating circuit, and a reactance in said supply circuit responsive to current variations in said supply circuit and mechanically associated with said first mentioned reactance for varying the current in said heating circuit in accordance with variations in said supply circuit.

5. An electric discharge system comprising a thermionic discharge tube provided with a hot-cathode, a power supply circuit therefor subject to variations, a high-tension transformer having its primary winding in said supply circuit, a heating circuit for the cathode of said tube, a low-tension transformer for supplying heating current to said heating circuit and having its primary winding in said supply circuit, a reactance in series with said cathode and the secondary winding of said low-tension transformer and a reactance in said supply circuit and provided with a magnetic core associated with said first mentioned reactance for varying the impedance of said heating circuit thus varying the current flowing in said heating circuit conversely to current variations in said supply circuit.

6. An electric discharge system comprising a thermionic discharge tube provided with a hot-cathode, a power supply circuit therefor subject to variations, a high-tension transformer having its primary winding in said supply circuit, a heating circuit for the cathode of said tube, a low-tension transformer for supplying heating current for said heating circuit and having its primary winding in said supply circuit, a reactance in said heating circuit, a reactance in said supply circuit varying with current variations in said supply circuit and mechanically associated with said first mentioned reactance for varying the current in said heating circuit in accordance with variations in said supply circuit, and means associated with said last mentioned reactance and said source for varying the degree of control of said reactance in response to current variations in said source.

7. An electric discharge system comprising a thermionic discharge tube provided with a hot cathode, a power supply circuit therefor subject to variations, a high-tension transformer having its primary winding in said supply circuit, a heating circuit for the cathode of said tube, a low-tension transformer for supplying heating current for said heating circuit and having its primary winding in said supply circuit, a reactance in said heating circuit, a reactance in said supply circuit varying with current variations in said supply circuit and mechanically associated with said first mentioned reactance for varying the current in said heating circuit in accordance with variations in said supply circuit and a resistance in series with said last mentioned reactance and said source for varying the degree of control of said reactance in response to current variations in said source.

In testimony whereof, I have hereunto subscribed my name this 24th day of December, 1930.

MONTFORD MORRISON.