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M. MORRISON

1,961,703

STABILIZER SYSTEM

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Fig. 1.

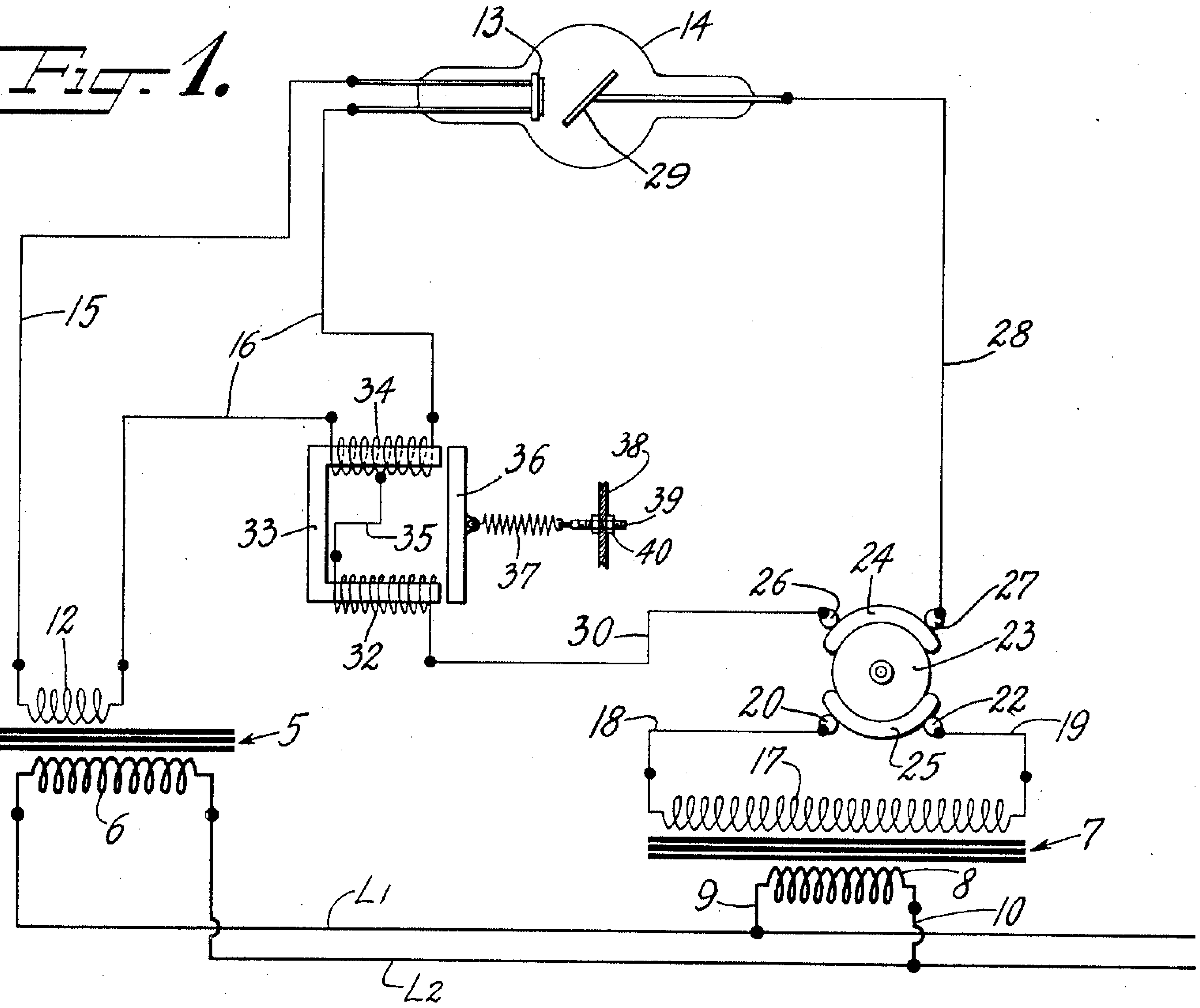
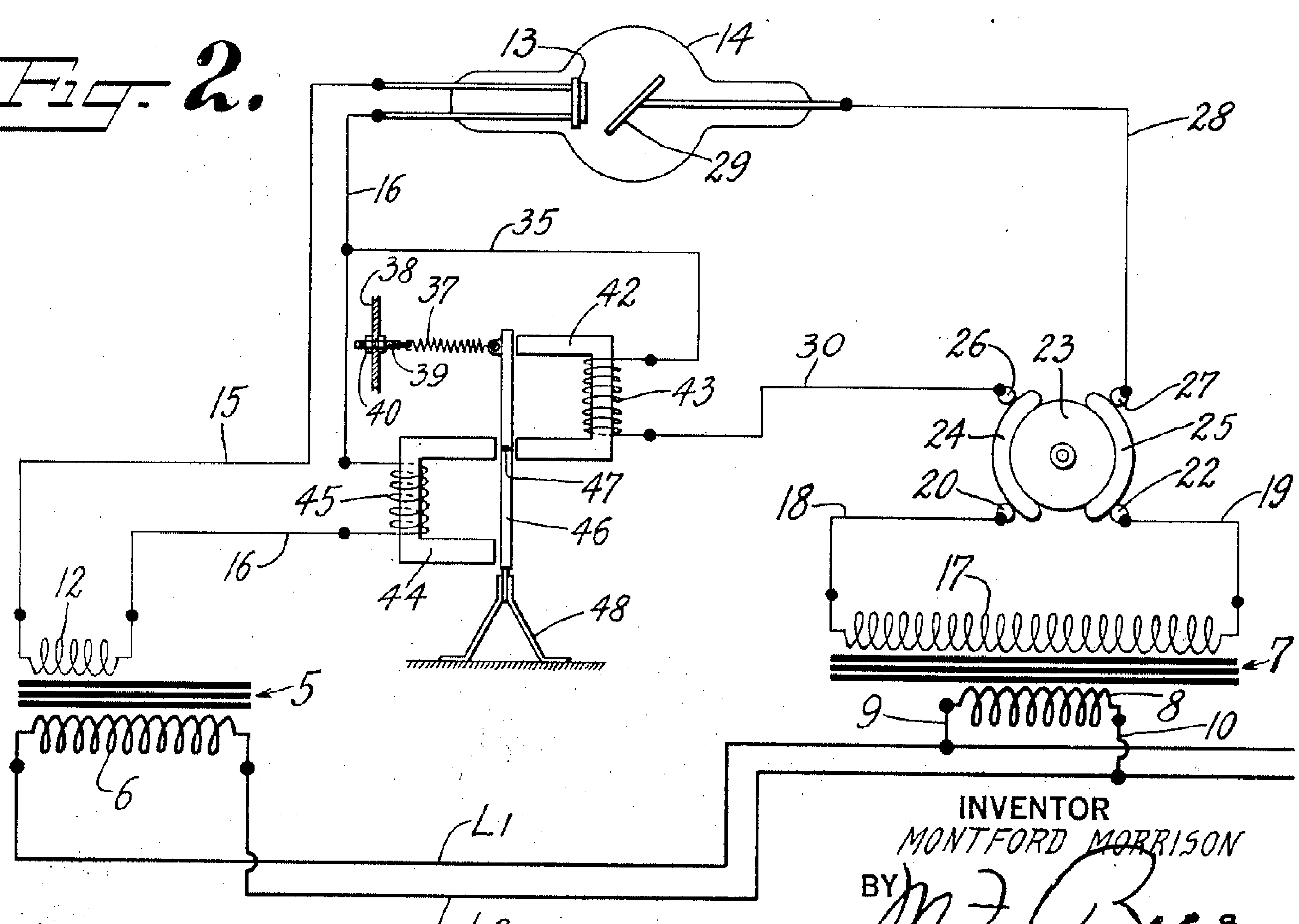


Fig. 2.



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STABILIZER SYSTEM

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5 Claims. (Cl. 250—34)

My invention relates to stabilizing systems and has particular reference to such systems utilized with discharge devices, such as X-ray tubes and the like, in which the operation is dependent upon thermionic cathodes.

In such systems it is customary to apply a potential between the electrodes of the device and to supply a heating current to the cathode. The electrical energy for this purpose is usually obtained from a source of alternating current potential which is subject to fluctuations and if not in some manner compensated for erratic flow results in the discharge device.

In order to prevent these supply source fluctuations from influencing the discharge circuit and causing a variation in the flow of current between the electrodes of the discharge device one controlling factor is that of maintaining the cathode heating current constant thereby precluding any variation in the temperature of the cathode. Other factors which tend to cause variations in the discharge current are also of major importance, such for example, as variations in the discharge circuit caused by gaseous ionization within the discharge device. There are other factors which likewise may affect the constancy of flow of the discharge current, but by controlling the above noted factors a degree of stabilization is obtained that renders all of the causes tending to vary this flow of infinitesimal consequence.

If the cathode heating current and consequently the temperature of the cathode is varied inversely to variations in the discharge circuit, regardless of the particular factor tending to cause such variation, the discharge current can be maintained constant without these factors influencing the discharge current to any appreciable extent.

It is accordingly an object of my invention to provide a system for stabilizing current in a thermionic discharge device by maintaining the thermionic emissivity of the cathode constant under all conditions of operation.

Another object of my invention is the provision of a stabilizer system for a thermionic discharge device in which the temperature of the cathode is varied in accordance with variations in the source of supply.

A further object of my invention is the provision of a stabilizer system for thermionic discharge devices in which the thermionic emissivity of the cathode is varied in accordance with variations in the discharge circuit to thus maintain the current flowing through the device constant.

Still further objects of my invention will become apparent to those skilled in the art by reference to the accompanying drawing wherein

Fig. 1 is a diagrammatic illustration of a circuit for energizing a thermionic discharge device embodying the features of my invention; and

Fig. 2 is a diagrammatic illustration of the same circuit showing a modification of my device.

Referring now to the drawing in detail I have shown in the figures a source of alternating current potential, such as conductors L1 and L2. A low tension transformer 5 has its primary winding 6 connected to this source of supply L1 and L2 and a high tension transformer 7 likewise has its primary winding 8 connected to the supply conductors L1 and L2 by means of conductors 9 and 10.

The secondary winding 12 of the low tension transformer 5 is connected to the cathode 13 of a thermionic discharge device 14 by means of conductors 15 and 16. The secondary winding 17 of the high tension transformer 7 is connected by means of conductors 18 and 19 to a pair of terminals 20 and 22 of a high tension rotary rectifier 23 which is driven by a synchronous motor (not shown). This rectifier is provided with a pair of toroidal surfaces 24 and 25.

Another pair of terminals 26 and 27 of the rectifier are provided and a conductor 28 extends from the terminal 27 to the anode 29 of the discharge device 14. A conductor 30 extends from the terminal 26 to a winding 32 of an impedance device having an iron core of substantial U shape 33. The other end of the winding 32 is connected to a second winding 34 by means of a conductor 35 which is likewise wound upon another leg of the iron core 33. This latter winding 34 is connected in series with the conductor 16 extending from the secondary winding 12 of the low tension transformer 5 to the cathode 13.

An armature 36 is provided for the impedance device and is tensioned by means of a coil spring 37 which is readily secured to a fixed location 38 by means of an adjustable connection, such as a stud 39 and nuts 40.

Referring now more particularly to Fig. 2 the structure therein shown differs from that shown in Fig. 1 in that an impedance device 42 having an iron core of substantially U shape is provided with a winding 43 which is connected with the conductor 30. A similar impedance device 44 having an iron core is provided with a winding 45 in series with the conductor 16.

It is readily apparent that in this modification the impedance devices with their respective windings are independent of one another instead of being wound upon the same core as previously described.

An elongated armature 46 extends across both of the impedance devices 42 and 44 and is pivoted at 47. One end of this armature is tensioned by means of the adjustable coil spring 37 in the same manner as the armature 36 shown in Fig. 1. The other end of the armature 46 is damped by means of a suitable device such as a fixed lug 48 which prevents vibration of the armature.

The operation of my device is as follows: Current being supplied to the primary windings 6 and 8 of the respective transformers 5 and 7 from the supply conductors L1 and L2 will induce a current in the respective secondary windings 12 and 17 of these transformers. The secondary winding 12 of the low-tension transformer 5 will supply heating current to the cathode 13 of a discharge device 14 by means of conductors 15 and 16. The secondary winding 17 of the transformer 7 will supply a high tension current to the terminals 20 and 22 of the rectifier 23 by means of the conductors 18 and 19. The rectifier 23 being rotated by a synchronous motor (not shown) will cause its toroidal surfaces 24 and 25 to rotate therewith and will establish during its rotation a connection between the terminals 20 and 22, and 26 and 27, as shown in Figure 1.

At this time, however, no current will flow to the discharge device 14 as no circuit is established from the secondary winding. When, however, the rectifier makes a quarter of a revolution to the position shown in Fig. 2, the toroidal surface 24 will establish a connection between the terminals 20 and 26 and the surface 25 will establish a connection between the terminals 22 and 27.

At this time high tension current will flow to the discharge device 14 in the following manner; from the secondary winding 17 by means of conductor 18 to the terminal 20, the toroidal surface 24 to the terminal 26, through conductor 30 to the impedance winding 32 by means of conductor 35 to the other impedance winding 34 to conductor 16 to the cathode 13, anode 29, through conductor 28 to the terminal 27 thence through the toroidal surface 25 to the terminal 22 and back to the secondary winding 17 by means of conductor 19.

It is readily apparent that this circuit is completed only during alternate half waves of the alternating current cycle by means of the rectifier device 23 and its toroidal surfaces 24 and 25. During the remaining half waves of the cycle the current induced in the secondary winding 17 will be prevented from passing by means of the rectifier device.

The armature 36 of the impedance device being adjusted by means of the nuts 40 for the amount of current desired need not be further disturbed. Assuming now that the current in the impedance winding 34, which is in series with the cathode 13, rises due to voltage fluctuations in the source of supply, which is induced in the secondary winding 12, the armature 36 will be attracted by the magnetic force set up or created by the winding 34 and will then permit the magnetic flux of the impedance device to pass through the armature 36.

The foregoing action of the armature increases the impedance of winding 34 and reduces the amount of current flowing through the winding 34, which likewise reduces current supplied to the cathode 13, consequently reducing the temperature thereof.

In the same manner should the current flowing in the discharge circuit increase due to gaseous ionization within the discharge device 14 or from any other factor the armature 36 will again be attracted to the core 33 of the impedance device by the current flowing through the windings 32 and a portion of the impedance winding 34. This again will alter the magnetic flux of the impedance device by attracting the armature 36 and increase the impedance of the winding 34 which is in series with the cathode 13. The increase of impedance of winding 34 decreases the current flowing to the cathode thus reducing the temperature and the thermionic emissivity of the cathode.

It is to be understood that the action of the armature 36 in varying the impedance of the filament heating circuit and the discharge circuit takes place due to variations in the source of supply or the discharge circuit during the cycle in which current is permitted to flow in the discharge circuit by the rectifier device 23.

When the rectifier device is in the position shown in Fig. 1 and current is prohibited from flowing due to the circuit to the discharge device being opened by the rectifier device, the spring 37 will retract the armature from the core 33 of the impedance device, the action, therefore, of the core would be that of a vibrator responsive to an increase of current in the impedance windings 32 and 34 above a predetermined amount.

The operation of the system shown in Fig. 2 is in most respects similar to that of the impedance device just described with the exception that the armature 46 is prevented from vibrating by the damper 48. In this modification the spring 37 is adjusted for the amount of current desired and when the current flowing through either of the windings 43 or 45 exceeds this amount the armature will be slightly rotated about its pivot 47 to thus vary the magnetic flux of the respective iron cores 42 and 44. Likewise in this modification the varying of the magnetic flux reduces the amount of current flowing in the winding 45 and again decreases the temperature and electron emissivity of the cathode.

The armature 46 where it engages the damper 48 is provided with a portion which is slightly flexible to enable a slight rotation of the armature about its pivot but sufficiently tensions the armature to prevent vibration.

It can, therefore, be readily seen that I have provided a stabilizer system in which the temperature and electron emissivity of the cathode may be readily varied inversely to fluctuations in a source of supply and to variations in the discharge circuit due to gaseous ionization within the device, or any other factors tending to vary the discharge current.

Although I have shown and described several embodiments of my device 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. The combination with an electron discharge device having a cathode to be heated, of a high tension transformer for supplying energy to the electrodes of said devices, a low-tension transformer for supplying heating current to the cathode of said device, a source of supply subject to

fluctuations for energizing both said transformers, and an inductance element provided with a winding in series with the electrodes of said device and a second winding in series with the cathode of said device for causing variations in said source and variations in current supplied by said high tension transformer, to maintain the current supplied to the electrodes of said device constant.

2. The combination with an electron discharge device having a cathode to be heated, of a high tension transformer provided with a secondary winding for supplying energy to the electrodes of said device, a low-tension transformer provided with a secondary winding for supplying heating current to the cathode of said device, a source of electrical supply subject to fluctuations common to the primary windings of both said transformers, and an inductance element provided with a winding connected in series with the secondary winding of said high tension transformer, and a second winding connected in series with the secondary winding of said low tension transformer, said inductance element windings being inductively related to each other to cause a variance in the current supplied to the cathode inversely to the fluctuations in said source of supply and to variations in current supplied by said high tension transformer for maintaining the current supplied to the electrodes of said device constant.

3. The combination with an electron discharge device having a cathode to be heated, of a high tension transformer provided with a secondary winding for supplying energy to the electrodes of said device, a low-tension transformer provided with a secondary winding for supplying heating current to the cathode of said device, a source of electrical supply subject to fluctuations common to the primary windings of both said transformers, an impedance device comprising a winding in series with the electrodes of said device, and the secondary of said high tension transformer, a second winding in series with the cathode of said device and the secondary of said low tension transformer, an armature for said impedance device, operable in response to the current flowing in both of said windings, for varying the magnetic flux of said impedance device to cause a variance in the current supplied to the cathode of said device, inversely to variations in said supply source and to variations in current supplied by the secondary winding of said high tension transformer to said device to maintain the current supplied to the electrodes of said device constant.

4. The combination with an electron discharge device having a cathode to be heated of a high tension circuit including a high tension transformer provided with a secondary winding, for supplying energy to the electrodes of said device, a low tension circuit including a low-tension transformer provided with a secondary winding for supplying heating current to the cathode of said device, a source of electrical supply subject to fluctuations common to the primary windings of both said transformers, an impedance device comprising a winding in series with the electrodes of said device and the secondary of said high tension transformer, a second winding in series with the cathode of said device and the secondary of said low tension transformer, a vibrating armature for said impedance device operable in response to the current in both of said windings, for varying the magnetic flux of said impedance device and altering the impedance of one of said circuits inversely to variations in the other of said circuits and said source of supply to maintain the current supplied to the electrodes of said device constant.

5. The combination with an electron discharge device having a cathode to be heated, a main energizing circuit for supplying high tension current to the electrodes of said device, a low tension circuit for heating the cathode of said device, a source of alternating current subject to fluctuations for supplying energy to both of said circuits, an inductance element provided with a winding in series with the electrodes of said device, an inductance element provided with a winding in series with the cathode of said device, an armature common to both of said inductance elements responsive to the current in said high and low tension circuits for varying the impedance of both of said circuits and varying the current in said low tension circuit inversely to variations in said high tension circuit and said source for maintaining the current supplied to the electrodes of said device constant.

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