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TERMINAL STRUCTURES FOR VALVE TUBES

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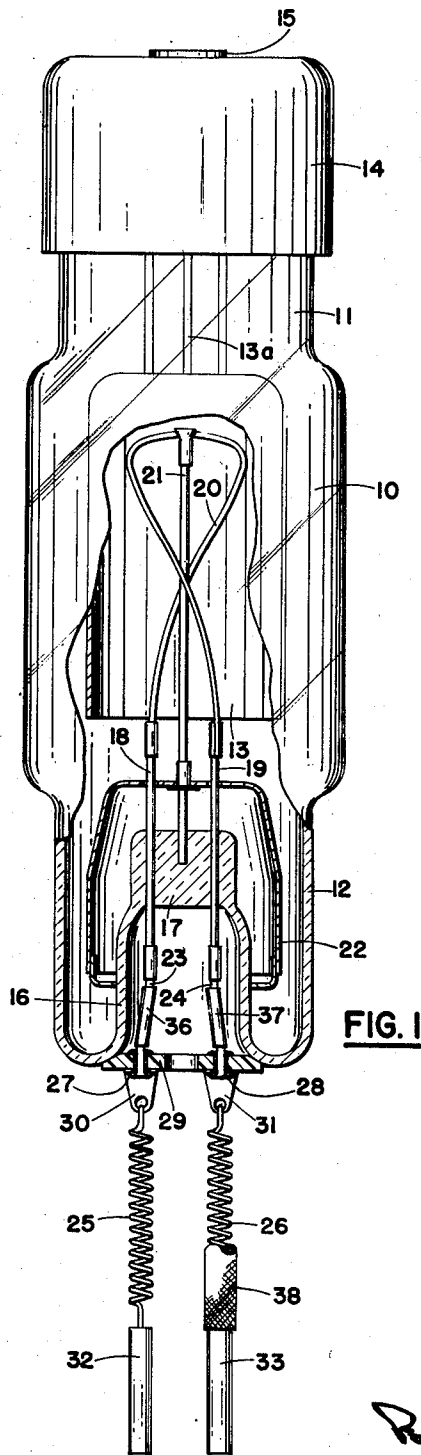


FIG. 1

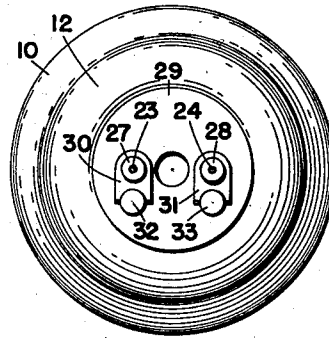


FIG. 2

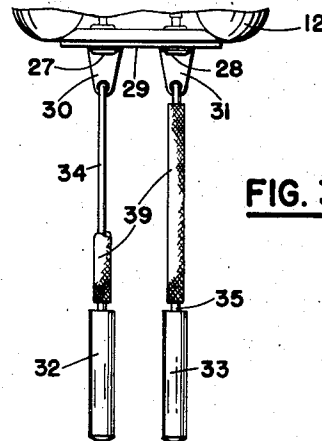


FIG. 3

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TERMINAL STRUCTURES FOR VALVE TUBES

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This invention relates to electron discharge devices and has particular reference to improved thermionic valve tubes such as used in the power supply circuits for X-ray tubes.

Thermionic valve tubes of the type referred to herein are generally high-voltage half-wave rectifier tubes which are used in X-ray apparatus, and which are intended for oil-immersed operation. In such tubes it is desirable to provide filaments which function at maximum efficiency with minimum power loss. It is particularly desirable to obtain high power output without the necessity of disposing of excess heat generated by lost power. To accomplish this, modern tubes of the presently described type are provided with filaments of thoriated tungsten or equivalent high emission material which requires relatively low filament voltage and power to attain a desired amount of emission. Thoriated tungsten filaments are also desirable because they may, by appropriate design considerations, be made to have considerably longer life than pure tungsten filaments.

Unfortunately, existing X-ray equipment is designed in most cases to supply higher voltages to tube filaments because old style tubes required higher voltages for operation of ordinary tungsten filaments. Thus, it has generally been difficult to replace old-style tubes with improved thoriated tungsten filament valve tubes without alteration of the filament supply circuits.

Accordingly, it is a primary object of the present invention to provide means whereby a valve tube having a filament requiring relatively low operating voltage may be used in circuitry which supplies relatively high voltage.

Another object is to provide novel means in a valve tube whereby a voltage dropping resistance is included in the filament circuit of the tube for permitting a normally low voltage filament to be operated from relatively high voltage sources.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is an elevational view partly in section illustrating a preferred embodiment of the invention;

Fig. 2 is an end view of the tube shown in Fig. 1; and

Fig. 3 is a fragmentary elevational view of the end of the tube shown in Fig. 1, illustrating a modification in the terminal structure.

The present invention is used primarily in connection with a valve tube which is supported in position of use by means connected to the anode of the tube or to any portion of the tube other than the extreme end through which extend the filament leads. The invention resides in the provision of flexible terminals which are connected directly to the filament leads and which comprise high resistance wires of the length necessary to reduce the voltage at the filament to the required level. The terminals are interchangeable with low resistance wires

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when it is desired to operate the filament at relatively low normal voltages or after appropriate adjustments have been made in the relatively high voltage circuitry.

Referring more particularly to Fig. 1, there is shown a tube which comprises a glass envelope having a cylindrical central portion 10 and end portions 11 and 12 of reduced diameter. Within end portion 11 is means for supporting a tubular anode 13 which extends longitudinally within the enlarged central portion 10. Enclosing the end of envelope portion 11 is a dielectric cap 14 the base of which carries an anode terminal 15 which is electrically connected to the anode 13. The cap 14 is rigidly affixed to the envelope and the terminal 15 is connected to an anode lead 13a within the cap 14.

The opposite end of the envelope is provided with a reentrant portion 16 which terminates in a stem press 17. Two spaced relatively rigid filament supports 18 and 19 extend through the stem press 17, and to the inner end of each support is fixed a respective end of a catenary type filament 20, the central portion of the filament being supported by one end of a third support 21 which has its opposed end fixedly mounted in the stem press 17.

A shield 22 is mounted over the stem press 17 and adjacent portions of the filament supports to protect them from electron bombardment.

The outer ends of filament supports 18 and 19 terminate slightly beyond the stem press 17 and within the recess formed by the reentrant portion 16, and to the end of each support 18 and 19 is fixed one end of respective flexible leads 23 and 24, which leads extend outwardly of the recess.

In accordance with the present invention, the filament 20 is designed for optimum operation when it receives relatively low voltages such, for example, as six volts. To permit the tubes to be used in equipment which supplies to the filament higher voltages such as ten volts, for example, means is provided at the tube for reducing the voltage between the power supply of the equipment and the filament. This means comprises a pair of voltage dropping resistors 25 and 26 which are secured to the respective filament leads 23 and 24 and which are formed of high resistance wire.

Leads 23 and 24 extend through respective eyelets 27 and 28 in a deck 29 which is adapted to close the recess formed by the reentrant portion 16 of the envelope, the inner peripheral edge of the deck being held upon the annular end of the envelope structure by the leads 23 and 24 which are pulled through the eyelets tight enough to hold the deck in place and are then soldered to the eyelets.

Also soldered, screwed, riveted or otherwise secured to the eyelets 27 and 28 are respective substantially L-shaped lugs 30 and 31 to which are connected ends of the respective resistors 25 and 26. The opposed ends of the resistors carry terminals 32 and 33 which are adapted to be plugged into the power supply circuit of the equipment with which the tube is to be used.

When this is done, the voltage applied to the terminals 32 and 33 divides, a portion of the voltage being expended at the resistors 25 and 26. Since the resistors are in series with the filament 20, the balance of the voltage is expended at the filament to raise the filament to its normal operating temperature. In this way a thoriated tungsten filament normally operable at six volts, for example, may be used in a power supply circuit which provides higher voltage, such as ten volts, as is required with conventional tungsten filaments.

Should the power supply circuit later be revised to supply six volts, the tube can then be used in the installation by merely removing the high resistance wires 25 and 26 and replacing them with the low resistance

wires 34 and 35 shown in Fig. 3, thus allowing the filament 20 to heat to its normal operating temperatures.

While the high resistance wires 25 and 26 are preferably soldered to the lugs 30 and 31, it will be apparent that they may be secured to the ends of the filament leads 23 and 24 by any other suitable means which provides satisfactory electrical conductivity between the leads and the wires. When a soldered connection is used, however, it is a simple operation to snip off the high resistance wires at the solder connection with the lugs and then solder low resistance wires in their place.

Since the tube is preferably supported in position of use by the anode terminal 15, the cathode terminals need not be rigid. This allows the wires to extend freely from the filament leads. However, to prevent accidental shorting should one of the leads 23 or 24 be inadvertently loose and movable, the leads are provided with sleeves 36 and 37 made preferably of a knitted dielectric fabric material. At least one of the high resistance wires 25 and 26, and also at least one of the low resistance wires 34 and 35, are likewise covered with dielectric sleeves 38 or 39 respectively to prevent shorting.

From the foregoing description it will be apparent that all of the objects of this invention have been accomplished by the provision of novel means for supplying valve tubes which are supported at locations other than the cathode ends thereof in various installations which supply different filament voltages to the tubes.

It will also be apparent that various modifications and changes within the scope of this invention may be made by those skilled in the art. Therefore, all matter shown and described should be interpreted as illustrative and not in a limiting sense.

I claim:

1. A valve tube comprising a vacuum envelope having a reentrant portion at one end extending for a substantial distance into the envelope and terminating in a stem press and forming a central cavity in that end of the tube exteriorly of the vacuumized portion of the envelope, a filament in the vacuumized portion of the envelope, a pair of leads connected with the filament and extending outwardly of the envelope through the stem press into the cavity, an apertured dielectric deck located on the end of the envelope spanning the cavity, a pair of electrically conductive members on the deck to which the outer ends of the leads are connected, a pair of metal lugs secured to and extending outwardly from the respective conductive members, and means carried by and forming part of the tube for connecting the filament to a source of power comprising a pair of conductive elements of selected electrical resistance characteristics having one end connected to the respective lugs, the conductive elements being freely suspended from the lugs and having their other ends adapted for connection to electrical means external of the tube.

2. A valve tube comprising a vacuum envelope having a reentrant portion at one end extending for a substantial distance into the envelope and terminating in a stem press and forming a central cavity in that end of the tube exteriorly of the vacuumized portion of the envelope, a filament in the vacuumized portion of the envelope, a pair of leads connected with the filament and extending outwardly of the envelope through the stem press into the cavity, a dielectric deck located on the end of the envelope and spanning the cavity, a pair of electrically conductive members on the deck and to which the outer ends of the leads are connected, a pair of metal lugs secured to and extending outwardly from the respective conductive members, means carried by and forming part of the tube for connecting the filament to a source of power comprising a pair of conductive elements of selected electrical resistance characteristics having one end interchangeably connected to the respective lugs, the elements being freely suspended from the lugs, and terminals on the other ends of the elements for connection to electrical means external of the tube.

3. A valve tube comprising a vacuum envelope having a reentrant portion at one end extending for a substantial distance into the envelope and forming a central cavity in that end of the tube exteriorly of the vacuumized portion of the envelope, a filament in the vacuumized portion of the envelope, a pair of relatively rigid supports connected with the filament and extending outwardly of the envelope into the cavity, a dielectric deck freely located on the end of the envelope and spanning the cavity, a pair of electrically conductive members on the deck, means carried by and forming part of the tube for connecting the filament to a source of power comprising a pair of conductive elements of selected electrical resistance characteristics having one end connected to the respective conductive members and freely suspended therefrom, and means for supporting the deck in position over said cavity comprising a pair of spaced flexible leads having one end connected to respective conductive members on the deck and having their other ends connected to respective supports, the connectors being relatively taut to prevent displacement of the deck and of electrically conductive material to supply electrical energy from said elements to the filament.

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