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G. S. MILES

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ELECTRON DISCHARGE TUBE

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FIG. 1

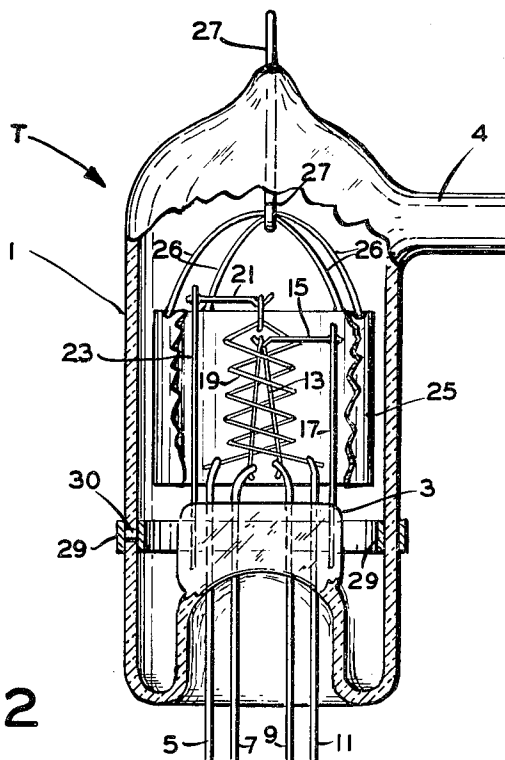
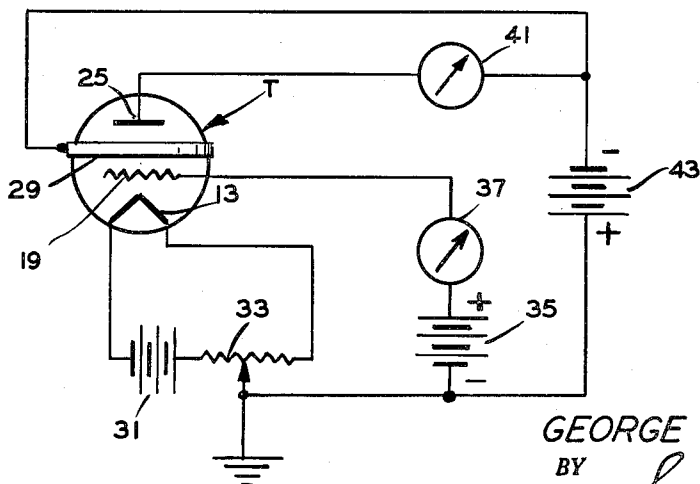


FIG. 2



INVENTOR.
GEORGE S. MILES

BY

St. Anthony
ATTORNEY

1

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ELECTRON DISCHARGE TUBE

George S. Miles, Englewood, N. J., assignor to Bendix Aviation Corporation, Teterboro, N. J., a corporation of Delaware

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8 Claims. (Cl. 324—33)

The invention relates to electron discharge tubes and more particularly to tubes which may be used for measuring high vacua.

Tubes used for this purpose usually include a plurality of electrodes such as a cathode, a collector plate, and a grid enclosed in an envelope. The grid is maintained at a positive potential relative to the cathode and the collector plate is maintained at a negative potential relative to the cathode. One of the difficulties experienced with tubes of this kind is in current leakage through the envelope from the grid to the collector plate. This current leakage causes serious errors in the measurement of vacua. It has been found that resistances as high as 10^{11} ohms between the grid and collector plate cause serious errors because of the high resistance of the collector circuit. Standard triodes usually include a leakage path between the grid and collector plate in excess of this value, and therefore are unsuitable for measuring high vacua.

The main object of the present invention is to substantially eliminate leakage between the grid and the plate in a multiple electrode tube.

Another object is to provide a tube which may be used to accurately measure vacua.

The invention contemplates an electron discharge tube having a plurality of electrodes including a grid and a collector plate enclosed within an envelope of insulating material and having leads for connecting the grid and collector plate in a circuit exteriorly of the envelope. A band of conducting material extends around the envelope and preferably is bonded thereto and is positioned in the leakage path between the collector plate and grid. The band preferably is connected to the collector plate potential source and shields the collector plate and its lead from the grid lead and thereby reduces current leakage through the envelope from the grid to the collector plate.

The foregoing and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawing wherein one embodiment of the invention is illustrated. It is to be expressly understood, however, that the drawing is for the purposes of illustration and description only, and is not to be construed as defining the limits of the invention.

In the drawing, Fig. 1 is an elevation view of an electron discharge tube constructed according to the invention, with parts of the tube shown in section and with parts of the tube broken away, and

Fig. 2 is a circuit diagram showing the tube used as an ionization gauge for measuring high vacua.

Referring now to the drawing for a more detailed description of the novel electron discharge tube of the present invention, the tube T is shown in Fig. 1 as comprising a cylindrical envelope 1 of insulating material, such as glass, having a re-entrant stem 3 at one end and having a tube-like portion 4 at the opposite end for con-

2

necting the tube to a device to be evacuated. A plurality of leads, 5, 7, 9, and 11, extend through stem 3 into the interior of the envelope. A heated filament 13 serves as the cathode and is connected at its ends to leads 7, 9, and is supported substantially at its mid-portion by an arm 15 welded or otherwise fixed to a support 17 secured to stem 3.

A grid 19 surrounds the filament and is mounted at its lower end on leads 5 and 11, and the upper end of the grid is supported by an arm 21 welded or otherwise fixed to support 23 mounted on stem 3.

A cylindrical collector plate 25 surrounds the grid and filament and is supported by arms 26 secured to a lead 27 extending through the end of the envelope adjacent to portion 4. The tube thus far described may be of conventional construction and is subject to current leakage through the envelope between grid leads 5, 11, and plate lead 27.

To substantially eliminate such current leakage bands 29 of conducting material are bonded or otherwise secured to the inner and outer surfaces of the envelope in the leakage path through the envelope between the grid and the collector plate to provide a shield therebetween. Bands 29 are connected together by a connector 30 extending through the envelope and the bands shield plate lead 27 from grid leads 5, 11. Grid leads 5, 11 preferably are spaced from plate lead 27 as far as possible so that the leakage path from the grid through the envelope to the plate is as long as possible and bands 29 are positioned between the points at which grid leads 5, 11 and plate lead 27 extend through the envelope. Bands 29 preferably are spaced as far as possible from plate lead 27 to increase the resistance between the bands and the plate lead so that when the bands are connected to the collector plate potential source, as shown in Fig. 2, leakage between the collector plate and the bands will be a minimum.

In Fig. 2 an electron discharge tube T of the kind described, constructed according to the invention, is used as an ionization gauge for measuring high vacua. Filament 13 is connected across a potential source 31 in series with a potentiometer 33 and to the grounded negative terminal of a D. C. source 35 and to the positive terminal of a D. C. source 43. Grid 19 is connected through a milli-ammeter 37 to the positive terminal of D. C. source 35. The grid is maintained at a positive potential relative to the filament and serves as an anode in that current flow is from the grid to the filament. Current flow from the grid of the filament is indicated on milli-ammeter 37 and may be stabilized by controlling the filament temperature. Electron current between the filament and the grid produces, by collision with gas molecules in the envelope, positive ions which are collected by collector plate 25 maintained at a potential negative relative to the grid and filament by its connection through a micro-ammeter 41 to the negative terminal of D. C. source 43.

The micro-ammeter is required to indicate minute currents and preferably is of the vacuum tube type having an input resistance in the order of 5 to 10 megohms. The ion current in the tube is a direct function of gas pressure and is measured by micro-ammeter 41 which may be calibrated in microns or millimeters of mercury or other suitable pressure reading. Bands 29 are connected in the circuit to the negative terminal of battery 43 and shield the plate lead from the grid lead and prevent leakage through the envelope between the grid and the collector plate so that micro-ammeter 41 provides an accurate indication of the vacuum being measured. Although leakage between the collector plate and the bands affects the accuracy of the device to a smaller degree than corresponding leakage from the highly posi-

3

tive grid to the negative collector plate, it is advantageous to reduce the first mentioned leakage to a minimum. For this reason the bands are positioned as far as possible from the plate lead.

Although but one embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

I claim:

1. An electron discharge tube, comprising an envelope of insulating material, two electrodes located within the envelope, leads from said electrodes extending through the envelope at spaced points, said electrodes being normally maintained at a sufficiently high voltage difference to produce harmful leakage current by conduction in a path extending along the envelope between said points, and means for preventing such leakage by conducting the leakage current away from said envelope, including a leakage absorbing element of conducting metal extending across said path in conducting contact with the envelope, and a leakage current conducting circuit connected to said element.

2. An electron discharge tube, comprising an envelope of insulating material, two electrodes located within the envelope, leads from said electrodes extending through the envelope at spaced points a circuit connecting said electrodes, said electrodes being normally maintained by said circuit at a sufficiently high voltage difference to produce harmful leakage current by conduction in a path extending along the envelope between said points, and means for preventing such leakage by conducting the leakage current away from said envelope, including a leakage absorbing band of conducting metal extending across the entire leakage path and continuously in conducting contact with the envelope, and a leakage current conducting circuit connected to said element and to said connecting circuit.

3. An electron discharge tube, comprising an envelope of insulating material, two electrodes located within the envelope, leads from said electrodes extending through the envelope at spaced points, said electrodes being normally maintained at a sufficiently high voltage difference to produce harmful leakage current by conduction in a path extending along the envelope between said points, and means for preventing such leakage by conducting the leakage current away from said envelope, including a leakage absorbing element extending across said path, said element comprising connected metal bands on the outer and inner faces of the envelope in conducting contact with said faces, and a leakage current conducting circuit connected to both of said bands.

4. An electron discharge tube, comprising an envelope of insulating material, two electrodes located within the envelope, leads from said electrodes extending through the envelope at spaced points, said electrodes being normally maintained at a sufficiently high voltage difference to produce harmful leakage current by conduction in a path extending along the envelope between said points, and means for preventing such leakage by conducting the leakage current away from said envelope, including a leakage absorbing element of conducting metal extending across said path in conducting contact with the envelope, the material of the envelope being in direct bonding engagement with the metal of said element, and a leakage current conducting circuit connected to said element.

5. An electron discharge tube circuit, comprising a tube including an envelope of insulating material, two electrodes located within the envelope, leads from said electrodes extending through the envelope at spaced points, an energizing circuit including connections to said

4

leads at a sufficiently high voltage difference to produce harmful leakage current by conduction in a path extending along the envelope between said points, and means for preventing such leakage by conducting the leakage current away from said envelope, including a leakage absorbing element of conducting metal extending across said path in conducting contact with the envelope and connected to said energizing circuit.

6. An ionization gauge system for measuring high vacua, comprising an electron discharge tube including an envelope of insulating material arranged for evacuation, electrodes located within said envelope including an electron receiving grid and an ion collector plate, leads extending from said grid and plate through the envelope at spaced points to sources of voltages sufficiently different to produce harmful leakage current by conduction in a path extending along the envelope between said points, and means for preventing such leakage by conducting the leakage current away from said envelope, including a leakage absorbing element of conducting metal extending across said path in conducting contact with the envelope.

7. An ionization gauge system for measuring high vacua, comprising an electron discharge tube including an envelope of insulating material arranged for evacuation, electrodes located within said envelope including an electron receiving grid and an ion collector plate, a lead extending from the grid through the envelope to a source of voltage, a lead extending from the collector plate through the envelope at a point spaced from the grid lead to a source of sufficiently different voltage to produce harmful leakage current by conduction in a path extending along the envelope between the leads, a leakage absorbing element of conducting metal extending across said path in conducting contact with the envelope, a leakage conducting lead connecting said element to the collector plate lead, arranged to discharge leakage current from the absorbing element, an indicator in the collector plate lead, and a connection between said element and the collector plate voltage source at a point beyond said indicator.

8. An ionization gauge system for measuring high vacua, comprising an electron discharge tube including an envelope of insulating material arranged for evacuation, electrodes located within said envelope including an electron receiving grid and an ion collector plate, leads extending from said grid and plate through the envelope at opposite ends thereof to sources of voltages sufficiently different to produce harmful leakage current by conduction in a path extending along the envelope between the leads, a band of leakage absorbing metal extending entirely around the envelope between said leads in continuous conducting contact with the envelope, a connected band of leakage absorbing metal extending entirely around the inner surface of the envelope between said leads in continuous conducting contact with the envelope, an indicator in the collector plate lead, and a connection between said bands and the latter lead at a point beyond the indicator.

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