

Jan. 20, 1970

K. FRANKE ETAL

3,491,232

HIGH VACUUM DISCHARGE TUBE FOR HIGH VOLTAGES

Filed Aug. 23, 1967

Fig.1

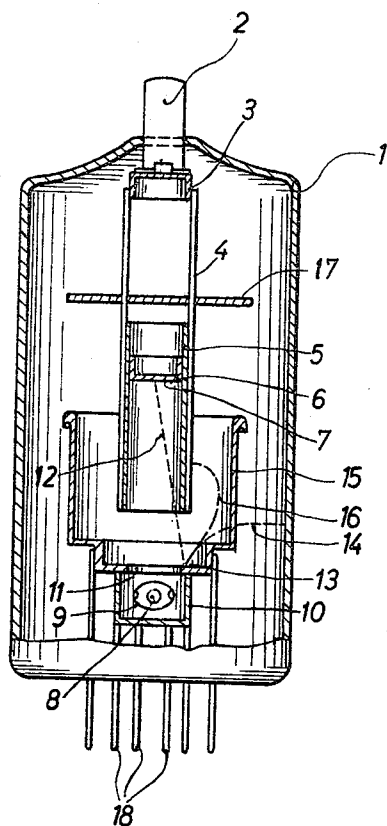
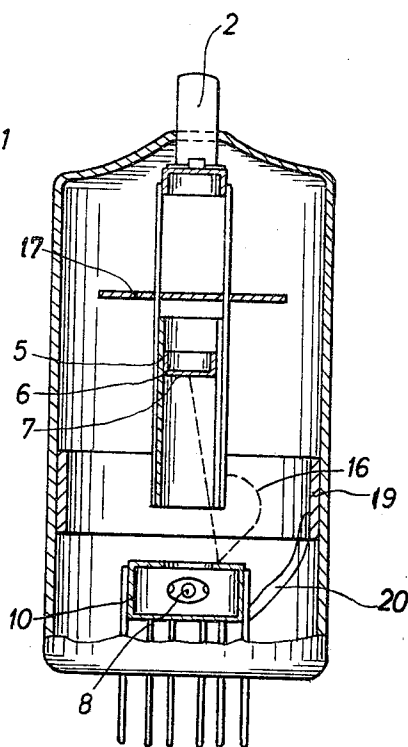


Fig.2



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3,491,232

HIGH VACUUM DISCHARGE TUBE FOR HIGH VOLTAGES

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Filed Aug. 23, 1967, Ser. No. 662,598

Claims priority, application Germany, Aug. 27, 1966,

P 40,278

Int. Cl. H01j 1/53

U.S. Cl. 313—240

6 Claims

ABSTRACT OF THE DISCLOSURE

A high vacuum, high voltage electron discharge tube having a cylindrical anode with a target surface at one end for receiving primary electrons and emitting photoelectrons which are prevented from striking the envelope of the tube by a shield which surrounds the anode and is between the end of the anode and a cathode shield. This shield is supplied with a potential relative to the anode which prevents the photoelectrons from striking the interior of the envelope but returns them to the interior of the anode.

The invention relates to a high vacuum discharge tube for high voltages comprising an anode cylinder having at least one open end and inside the cylinder an anode surface arranged perpendicular to the cylinder axis and furthermore comprising a cathode placed outside the cylinder and being surrounded by screening means, said screening means having an opening provided with screening surfaces, and located at some distance opposite the open end of the anode cylinder.

In some known high vacuum discharge tubes screens are provided to prevent surface charges being formed on the wall of the vessel and also to prevent primary or secondary electrons from leaving the cathode-anode space unintentionally.

Such discharge tubes have a cathode or electron emitting filament placed inside a generally cylindrical anode. However, the known screening means are not suitable for high vacuum discharge tubes for high voltages as these tubes are exposed to temperatures which require screening means of a particular type. With the known means an effective screening cannot be realized.

In high vacuum rectifier tubes in particular for high and very high voltages, screening means are known which surround a cylindrical anode at such a distance, that the anode surfaces exposed to electron bombardment are situated inside the screening cup.

These screening means are intended to prevent charged carriers escaping from the active discharge space and thus can no longer reach the wall of the vessel which otherwise would cause in the long run a brownish discoloring of the glass.

The so-called ballast tubes as presently available also show this brownish discoloring. These ballast tubes are used in color television receivers in which they are connected in parallel with the colour picture tube in order to keep constant the sum of the currents through the picture tube and the ballast tube. This is an essential function as otherwise the colors will not be reproduced correctly. The ballast tubes are triodes, which show as soon as they are switched on fluorescence of the glass wall which disappears when the tube has been in operation for a longer time and then changes into a brownish discoloring of the glass. It appears that the discoloring results from a decomposition of the lead oxide contained in the glass. The higher the operating voltage of the tube,

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the greater is the decomposition of the lead oxide and this will finally result in the destruction of the glass vessel.

As already mentioned the anode surfaces of these high vacuum discharge tubes for high voltages are situated inside an anode cylinder such that the anode surfaces, viewed in the direction of the electron stream, lie deep in the cylinder. Thus, it is unlikely, that secondary electrons set free at the anode by the bombarding primary electrons, can leave the anode cylinder in a direction opposite to the direction of motion of the primary electron stream and can arrive at the glass wall. The problem underlying the invention was first of all to establish the physical phenomena leading to the brownish discoloring of the glass of the ballast tubes. As a result of measurements the inventors found, that at very high voltages a radio-active radiation is set free by the electron bombardment of the anode surface situated deep in the anode cylinder. This radiation strikes the surfaces of the cathode screening means and liberates at these surfaces primary electrons which can travel to and reach the glass wall unhindered. This phenomenon has up to now not been observed in electron tubes of the type mentioned. Therefore according to the invention there are provided in a high vacuum discharge tube for high voltages of the above-mentioned type screening means such that photoelectrons, liberated at the screening surfaces by radio-active radiation emanating from the anode surface and produced by electron bombardment of that surface situated rather deep inside the anode cylinder, are prevented from reaching the wall of the vessel and are forced to return to the anode cylinder.

According to the invention the screening means may consist of a cup fixed to the cathode screening means and provided with a current supply lead, said cup surrounding the anode cylinder up to a certain height and also surrounding the space between the cylinder and the screening surfaces. The cup itself may be provided with a supply lead leading to the outside of the tube. Alternatively, according to the invention, the cup may be electrically connected to the cathode screening means which results in a simpler construction.

In many cases it is sufficient to use as screening means according to the invention, a metal ring adjacent to the tube wall, and to provide the ring with supply lead leading to the outside of the tube. According to the invention this metal ring is fixed to the cathode screening means and is electrically connected thereto. Moreover it is possible to connect the cathode screening means to the cathode of the tube in the same way as it is done in known tubes. At variance with known arrangements according to the invention not only is the anode screened but all surfaces of the discharge system which might be exposed to the radioactive radiation and which in consequence thereof could give off photoelectrons proceeding to the wall of the tube.

The drawing shows several embodiments of the invention which will be explained hereafter.

In the drawing:

FIGURE 1 shows, partly in a cross-sectional view, a ballast tube for color television receivers provided with a screening cup according to the invention.

FIGURE 2 shows likewise a ballast tube for colour television receivers provided with a metal screening ring according to the invention.

In FIGURES 1 and 2 the glass vessel of the tube is designated by the numeral 1. An anode cap 2, fused in the glass wall and projecting from the outside of the tube, carries an anode-cylinder 5 by means of a support 3 and supporting rods 4. Inside this anode cylinder and perpendicular to its axis is situated a cup shaped body 6 having an anode surface 7.

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At the bottom of the tube and standing thereon is arranged a cathode 8 surrounded by a grid 9; both are placed inside a cathode screen 10. The screen 10 has an opening 11 through which the electrons emitted by the cathode 8 after having passed the grid 9 can proceed to the anode cylinder 5. These electrons are accelerated by a voltage of about 25,000 volts applied between the anode cylinder 5 and the cathode 8 and hit at a very high speed the anode surface 7. This electron bombardment sets free a radioactive radiation which is emitted in the direction to the cathode. This radiation indicated by the dotted line 12 reaches the surface 13 of the cathode screen 10 and there sets free photoelectrons which leave the surface for instance as indicated by the dotted line 14. In tubes of the known types the photoelectrons would reach the glass wall 1 unhindered. According to the invention there is arranged a screening cup 15 such that the electrons 14 set free by the radioactive radiation travel in the direction of the dotted line 16, that is to say in the direction to the anode and consequently are prevented from reaching the glass wall. The lifetime of ballast tubes provided with such a screening cup is substantially longer than the lifetime of the tubes hitherto known.

Plates 17 are arranged in order to reflect heat radiation. Furthermore the tube is provided with contact-pins 18.

In the embodiment according to FIGURE 2 a metal ring 19 adjacent the tube wall 1 is used instead of the screening cup. The ring is connected by means of a lead 20 to the cathode screen 10 and also to the cathode 8 such that both the ring and the screen 15 modify the course of the equipotential lines, thereby forcing the photoelectrons to turn back and preventing them from traveling to the glass wall.

What is claimed is:

1. A high vacuum discharge tube for high voltages comprising an evacuated envelope and within said envelope an anode cylinder having at least one open end and inside the cylinder an anode surface arranged perpendicular to the cylinder axis a cathode placed outside the cylinder, screening means surrounding the cathodes, said cathode screening means having an opening provided with screening surfaces and located spaced from and opposite the open end of the anode cylinder, additional screening means surrounding the open end of said anode between said envelope and said cathode screening means for intercepting photoelectrons liberated at the said

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screening surfaces by radioactive radiation emanating from the anode surface and produced by electron bombardment of that surface situated within the anode cylinder, and means to apply a potential to said latter screening means for returning the photoelectrons to the anode cylinder.

2. A high vacuum discharge tube according to claim 1 where the additional screening means comprise a cup fixed to the cathode screening means and provided with a current supply lead, said cup surrounding the anode cylinder up to a certain height and also surrounding the space between the cylinder and the screening surfaces.

3. A high vacuum discharge tube according to claim 2, wherein the screening cup is electrically connected to the cathode screening means.

4. A high vacuum discharge tube according to claim 1 wherein the additional screening means comprise a metal ring adjacent the tube wall, said ring being provided with a current supply lead.

5. A high vacuum discharge tube according to claim 4, wherein the metal ring is fixed to the cathode screening means and is electrically connected thereto.

6. A high vacuum discharge tube according to claim 1 wherein the additional cathode screening means are electrically connected to the cathode.

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ANDREW J. JAMES, Assistant Examiner

U.S. Cl. X.R.

313—285, 299, 313, 325

(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3491232 Dated January 20, 1970

Inventor(s) KURT FRANKE and KURT HIRSCH

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 3, line 10, after "emitted" insert

--perferentially--

Signed and sealed this 14th day of July , 1970

Ⓢ(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents