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ELECTRICAL APPARATUS

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FIG. 1.

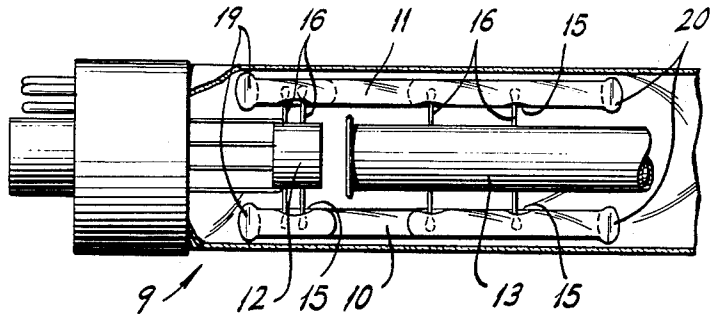


FIG. 2.

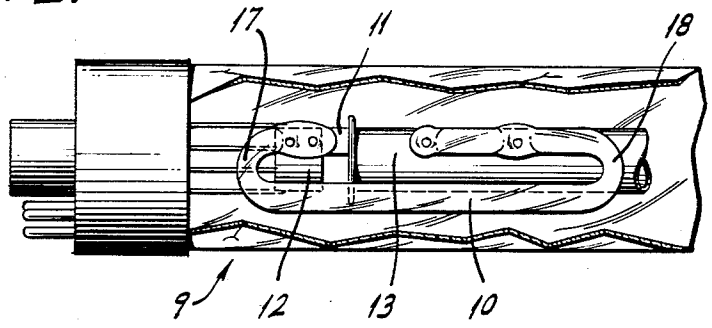
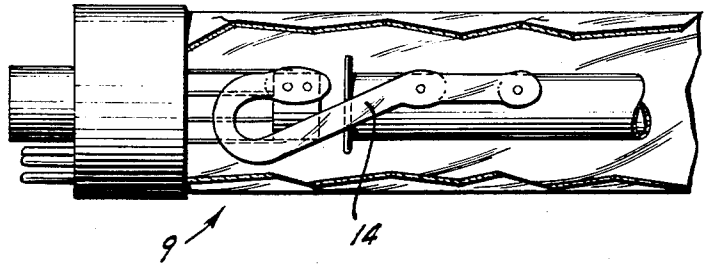


FIG. 3.



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ELECTRICAL APPARATUS

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This invention relates to evacuated electron discharge devices, and more particularly to improved interelectrode insulating arrangements employed therein.

Problems which have received considerable attention in the prior art, particularly in the case of television high illumination projection tubes, are those dealing with means for increasing the brightness of the phosphorescent screen and for improving the apparent contrast of objects imaged thereon. This problem is particularly acute in color television tubes where the efficiency of the phosphors is down nearly an order of magnitude from that found in black and white sets.

A factor which has considerable influence on the aforesaid brightness characteristics is the anode potential, this being largely determinative of the accelerating force impressed on the beam of electrons emitted from the cathode. Since the intensity of light emitted by phosphorescent materials is proportional to the excitation induced by the impacting electrons, and since the energy of the electron beam is directly proportional to the anode voltage, it is apparent that a contribution enabling the imposition of anode potentials higher than presently feasible would be most promising in solving the brightness problem. Moreover, increase of anode voltage has the additional advantage of advantageously affecting the spot size.

In attempting to accomplish either or both of the aforesaid objects, namely of increasing the brightness of a phosphorescent screen or reducing spot size, any appreciable increase of the anode voltage over presently existing norms has resulted in high voltage breakdown, a condition which normally manifests itself in breakdown of the interelectrode insulating support means, as for example by fracturing of the interelectrode insulating bead or rod, or by high voltage arcing which takes place along the surface of one or more of the insulating support members.

It has therefore become necessary, as a prerequisite to the use of higher operating potentials, to provide interelectrode insulating means that will withstand these desirable higher voltages.

It is consequently a primary object of this invention to provide a method of supporting the electrode elements within an electron gun structure of the type used in cathode ray tubes so as to prevent or mitigate high voltage breakdown of the interelectrode insulators.

In the illustrated embodiment, the invention is featured by the provision of an electron gun which is of very simple yet very rigid construction, and contemplates a unique design for overcoming certain of the limitations of prior art devices.

It is another object of this invention to provide a simple inexpensive means for overcoming prior art limitations, and for enabling the imposition of exceedingly high potential gradients between interelectrode elements of an evacuated electron discharge device.

These and other objects within contemplation will be

readily understood by reference to the following detailed description and the accompanying drawing in which:

Figure 1 is a plan view of an electron gun structure embodying the present invention, the structure being shown in position in the neck of a tube;

Figure 2 is a side elevational view of the apparatus shown in Figure 1; and

Figure 3 is a view showing an alternate embodiment.

First briefly described, the illustrated embodiment of the invention depicts an electron gun structure of the type used in cathode ray tubes, comprising a cathode, control grid and anode, the latter two elements being held in rigid axial alignment by insulating support members of high dielectric strength.

Given a fixed axial electrode spacing the impasse in present design has been the absence of a method of preventing breakdown of the dielectric supporting members once high anode voltages have been imposed. Excellent insulators, such as glass and mica, break down and carry current when a great enough voltage is applied, hence if a high enough electric field is impressed and maintained, the insulator becomes heated with the final result that some electrons leave their atoms. The electric field then urges the electrons through the substance of the insulator, resulting in a small leakage current. Generally the partial breakdown of an insulator, as described above, is rapidly followed by a complete breakdown; the current flowing through the insulator, even though small, generates more heat, thereby pyramiding its disruptive effect.

A condition which further aggravates this problem of high voltage breakdown is the microscopic deposition of conductive materials on the surface of the insulating support structure. This deposition results from the gradual release of metal vapors and other substances occluded or absorbed within the various internal members of the tube assembly. This phenomenon produces a secondary electrical path along the surface of the insulating bead, and high voltage arcing which occurs via this route produces ionization of the residual gas particles within the tube, thereby deleteriously contributing to cathode poisoning, attrition of the emissive surface of the cathode and the condition known as "ion spot." Moreover, original contamination of the insulator surface, even in the absence of the aforesaid conditions, provides a sufficiently conductive path for high voltage arcing.

When vitreous dielectric materials, such as glass, are employed as insulating support members, it has been found that in the manufacture of the insulating bead, numerous longitudinal capillary size passages are formed within the internal structure, caused by bubbles in the melt being elongated in the drawing operation. These capillaries contain gas under reduced pressure which ionizes when subjected to an electric field. This produces heating with attendant expansion of the entrapped gas, a condition ultimately leading to destruction of the vitreous insulator.

Regardless, however, of the reasons for insulator failure the fact remains that the unique structural design herein taught greatly extends the insulating range of such elements and enables the use of higher operating potentials within the evacuated electron discharge device.

Now making detailed reference to the drawing and particularly to Figure 2 thereof, there is shown an electron gun structure 9, disposed within a neck portion of a cathode ray tube, comprising the open oval shaped insulating beads or canes 10 and 11 whose function it is to insulate the control grid 12 from the extremely high voltages impressed on the anode 13, and to additionally maintain the necessary interelectrode spacing and desired rigid predetermined axial alignment of said electrode members.

Prior practice maintained these electrodes in spaced relation by running straight glass beads rectilinearly between junction points, such construction admitting of only moderately high voltage differentials between grid and anode before the occurrence of high voltage arcing. By the simple expedient of altering the bead shape, as by conveniently using the open oval shaped bead **10**, or in the alternative, the question mark shaped insulator **14** of Figure 3, the electrical leakage path between insulator-electrode junctions **15** can be appreciably extended thereby effectively increasing the resistance of said path without the necessity of increasing the interelectrode spacing which would in turn necessitate lengthening of the overall gun structure. The term electrode-insulator junction is to be construed, for purposes of this invention, as being the interface or point of demarcation between the insulator and the conducting surface of the electrode element. In the revised showing in Figure 1, for example, the electrode-insulator junctions are the points **15** at which the metal electrode tabs **16** join the insulators **10** and **11**.

This technique of interposing an insulator defining an extended leakage path between members maintained at widely different potentials, without changing pre-existing physical parameters, has resulted in an insulating method characterized by simplicity of design and one which is readily adaptable to present structural embodiments. By using an insulating configuration, as depicted in the drawing, voltages of considerably greater magnitude than presently attainable may be employed while still maintaining previous interelectrode spacing. The effective elongation of the leakage path between predetermined, fixed electrode-insulator junctions is the essence of the present invention, and when it is realized that the brightness factor of the phosphors is approximately proportional to the anode voltage, it will be apparent that the technique here shown, for enabling the imposition of higher anode voltages than heretofore possible, has appreciable significance.

When employing glass, ceramics, or other vitreous materials, as the insulating media, it has often been found, as previously mentioned, that there is within the insulator rod an internal longitudinal gas filled capillary passage which serves to bridge the interelectrode gap. The electrode insulating method here shown obviates this problem, as well as those aforementioned, in that formation of the arcuate contours **17** and **18**, as shown for instance in Figure 2, serve to distort the cross sectional configuration of positions **19** and **20** effectively collapsing these internal gas pockets, thereby preventing voltage breakdown resulting from this cause. It will, of course, be understood that any mode of deforming the bead structure in a plane substantially transverse to its longitudinal axis will be effective in eliminating this particular cause of insulator failure, as for example by applying a torsional stress to the bead during the formative stage to thereby distort the bead cross section, collapsing any internal capillary gas pocket.

While a preferred embodiment of this invention has been shown and described, it will be understood that such modifications and changes are contemplated as may come within the scope of the appended claims.

We claim:

1. For an evacuated electron discharge device, an electrode assembly comprising, a plurality of electrodes, and elongated, generally rod-like, vitreous insulating means joined to and supporting said electrodes in spaced relation, the length of said insulating means, between electrode-insulator junctions, being greater than the rectilinear distance between said junctions, and said insulating means being so shaped as to cause, in at least one portion thereof, distortion of its cross sectional configuration.

2. For an evacuated electron discharge device, an electrode assembly comprising, a plurality of generally tube-like electrodes, and elongated, vitreous insulating means joined to and supporting said electrodes in spaced, generally axial alignment, the length of said insulating means, between electrode-insulator junctions, being greater than the rectilinear distance between said junctions, and said insulating means being so shaped as to cause, in at least one portion thereof, distortion of its cross sectional configuration.

3. For an evacuated electron discharge device, an electrode assembly comprising, a plurality of electrodes, and elongated rod-like generally **C**-shaped insulating means joined to and supporting said electrodes in spaced relation, the length of said insulating means, between electrode-insulator junctions, being greater than the rectilinear distance between said junctions and effective materially to increase the resistance between said junctions over that which would obtain using a rectilinear length of said insulating means.

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