March 16, 1943. J. A. VICTOREEN 2,314,060

ELECTRICAL APPARATUS

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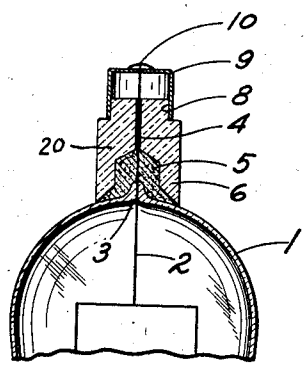


Fig. 1

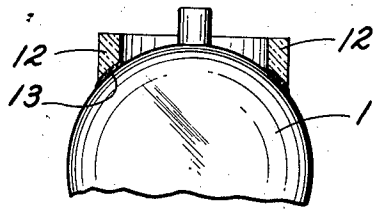


Fig. 2

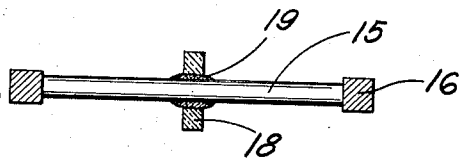


Fig. 3

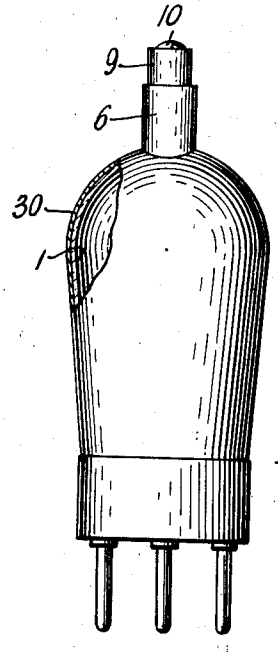


Fig. 5.

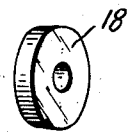


Fig. 4.

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ELECTRICAL APPARATUS

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16 Claims. (Cl. 250—27.5)

This invention relates to improvements in electrical apparatus, and more particularly to a means and method of increasing surface resistivity in certain electrical devices such as insulators, vacuum tubes, and the like.

Heretofore one of the more important problems to be solved in electrical devices, particularly those dealing with small electrical charges and currents, has been the elimination of surface leakages. For example, certain types of vacuum tubes, although adaptable for use in circuits where extremely small currents or charges were being handled might be satisfactory for certain periods of time, atmospheric conditions caused a deposition of moisture on the surface, or aging of the surface which made the tubes unsuitable for use at a subsequent period. Many methods and means have been proposed to solve this problem, including that of keeping the apparatus in an atmosphere where the humidity could be controlled. Tubes have been constructed which would operate over a considerable period of time, but there was no means of determining this period so that it could be definitely told when the surface-resisting had changed and might thus affect the measurements being made. Keeping the apparatus in a controlled atmosphere obviously curtailed the use to which the apparatus could be put.

By my present invention I have discovered a means whereby, with a few simple changes in the construction of the tube, surface leakage is eliminated and the tubes may be operated over a long period of time without attention.

The principle of my invention, however, is not limited in its application to vacuum tubes, since it may be used in other places where it is desired to eliminate surface leakages of charges or currents.

The invention, generally speaking, includes the securing of a high surface resistivity material by a high volume resistivity cement to a low surface resistivity material.

The inventoin will become more apparent from the following description of some embodiments thereof, which description is illustrated by the accompanying drawing and forms a part of this specification.

In the drawing:

Fig. 1 is a fragmentary vertical section of the upper end of a vacuum tube showing the control grid lead;

Fig. 2 is a similar view of a modified form;

Fig. 3 is a view partly in elevation and partly in section of another modification of the invention;

Fig. 4 is a perspective view of the elements shown in Fig. 3.

Fig. 5 is a view of a vacuum tube with certain parts broken away and shown in section.

Throughout the drawing, like parts have been designated by like reference characters.

The invention as first described is applied to the control grid of a vacuum tube of the type where the grid is lead out through the top of the envelope. In this instance the glass envelope is indicated at 1 through which the grid lead 2 extends, and the lead is sealed air-tight by the portion 3. Normally the grid cup is soldered to the lead and cemented around the portion 3; in this instance, however, the lead extends somewhat longer than is conventional, and a bead or bushing 20 of amber is disposed over the lead 2 and portion 3 with the lead extending through the bushing via a central opening 4. The bushing is counterbored at 5 to permit the same to pass over the portion 3 and is cemented securely on the end of the tube and the portion 3 by a quantity of De Khotinski cement. The De Khotinski cement, as is well known to those versed in the art, comprises a combination of shellac and Caroline pitch. The skirt 6 of the bushing fits down closely against the glass surface of the tube envelope. The end of the bead is provided with an annular shoulder 8 on which is disposed the grid cap 9 to which the grid lead is soldered at 10.

The De Khotinski cement provides a high volume resistivity and secures the amber bead, which has an extremely high surface resistance, securely to the end of the tube.

If desired, the surface of the tube may be coated with colloidal graphite 30 up to the cement seal, which prevents electrical charges from creeping across the surface of the tube which would effect a gradual change in the tube characteristics.

In Fig. 2 I have shown another form where the amber comprises a ring 12 of relatively large diameter disposed on the end of the tube concentrically to the grid cap. This ring is also cemented to the surface of the tube at 13 with De Khotinski cement. The device has the disadvantage that a larger quantity of amber is necessary which, being relatively expensive, materially increases the cost. The operation is, however, substantially the same.

In Fig. 3 I have illustrated another application of the invention. In this instance it is desired to prevent surface creepage of currents on a glass rod 15 which may be an insulator or support for certain types of electrical apparatus. 16

represents the ends of the rod adapted to be connected to or between other parts of the apparatus, not shown. In this instance a torroidal element of amber 18 is cemented by De Khotinski cement 19 to the mid-section of the rod.

As previously stated, the amber has an extremely high surface resistance to creeping charges or currents. It thus acts as an electrical dam, which when interposed in the path of creeping currents effectively prevents the current from passing thereover. The De Khotinski cement is well known as a high grade volume insulator and effectively holds the amber in place.

Furthermore, I have discovered that the amber is not materially affected by normal atmospheric conditions, thus making its electrical property of high resistivity obtainable over considerably longer periods of time.

Substitutes for amber such as poly-styrene may be used and have been found to be effective. Although I have described my invention by illustrating certain constitutents thereof, I am aware that numerous and extensive departures may be made from the specific disclosure without departing from the spirit or scope of the invention.

I claim:

1. In combination with a vacuum tube adapted for operation in normal room conditions of temperature and humidity having an envelope and provided with an electrode lead extending therethrough, means to prevent surface leakage of electrons across said envelope to the lead comprising an electrical dam having the characteristics of extremely high surface resistance to electron creepage, and means to hold said dam in place comprising a material of high volume resistance to electron current therethrough.

2. In combination with a vacuum tube having an envelope and an electrode control lead extending through the envelope, means to prevent current leakages across the surface of said envelope to and from said electrode lead comprising a material of high surface resistance to electron creepage disposed about said electrode lead, and a cement of high volume resistance to electron current therethrough holding said material in position and sealing the surface to said first mentioned material.

3. In an apparatus for eliminating surface leakage across a surface having relatively low surface resistivity under operating conditions of normal room temperature and humidity comprising an amber dam interposed in the electrical path for said currents, and means for holding said amber dam in sealed engagement therewith comprising a cement having the characteristics of high volume resistance therethrough.

4. In an apparatus for eliminating surface leakage of electrons across a surface having relatively low surface resistivity and operating under conditions of normal room temperature and humidity comprising an amber dam interposed in the electrical path for said electrons, and means for holding said amber dam in sealed engagement therewith comprising De Khotinski cement having the characteristics of high volume resistance to electron flow therethrough.

5. In combination with a vacuum tube having an envelope of low surface resistance to electron flow and having a tube element lead extending through said envelope, means for preventing surface current and voltage leakages to and from said lead across the outside of said envelope comprising a poly-styrene or like bushing surrounding said lead, means for securing said bushing to said envelope comprising De Khotinski cement and a grid electrical contact member supported on the end of said bushing and connected to said lead.

6. A vacuum tube including an envelope and electrodes therein, a lead from one of said electrodes extending in sealed relation through said envelope, an amber bushing surrounding said lead at the point of emergence from the envelope and secured to said envelope by De Khotinski cement, said bushing being hollow, the lead passing therethrough, a cap supported by the end of the bushing and connected to said lead and a coating of conducting material covering the outer surface of said envelope from the base to the amber bushing.

7. A vacuum tube including an envelope and electrodes therein, a lead from one of said electrodes extending in sealed relation through said envelope, a poly-styrene or like bushing surrounding said lead at the point of emergence from the envelope and secured to said envelope by De Khotinski cement, said bushing being hollow, the lead passing therethrough, a cap supported by the end of the bushing and connected to said lead and a coating of colloidal graphite covering the outer surface of said envelope from the base to the bushing.

8. The method for increasing the resistance of the surface of a material in an electrical apparatus operating at normal room temperature and humidity to the creepage of electrons which comprises interposing in the path of current travel a material having a high surface resistance to the creepage of electrons and holding said material in said path by a material having a high volume resistance to the passage of electrons therethrough.

9. In combination with an electrical apparatus having a current leakage path of low surface electrical resistance in the presence of gas at normal temperature and humidity, means to increase the surface electrical resistance of said path which comprises an electrical dam of a material having a high surface resistance to electron flow disposed in said current leakage path and means to hold said dam in position comprising a material of high electrical volume resistance to electron flow.

10. A vacuum tube including an envelope and electrodes therein, a lead from one of said electrodes extending in sealed relation through said envelope, a bushing of high surface resistance to electron creepage surrounding said lead at the point of emergence from the envelope and secured to the exterior of said envelope by a cement having high volume resistance to electron creepage, said bushing being hollow, said lead extending therethrough, a cap supported by the end of the bushing and connected to said lead and a coating of conducting material covering the outer surface of said envelope from the base to the bushing.

11. A vacuum tube including an envelope having electrodes therein, a lead connected to one of said electrodes and extending in sealed relation through said envelope, an amber bushing surrounding said lead at the point of emergence from the envelope and secured to the exterior of said envelope by De Khotinski cement, said bushing being hollow, said lead extending therethrough, and a cap supported by the end of the bushing and connected to said lead.

12. A vacuum tube including an envelope and electrodes therein, a lead from one of said elec-

trodes extending in sealed relation through said envelope, an amber bushing surrounding said lead at the point of emergence from the envelope and secured to said envelope by De Khotinski cement, said bushing being hollow, the lead passing therethrough, a cap connected to said lead, and a coating of conducting material covering the surface of said envelope from the base to the bushing.

13. In an apparatus for eliminating surface leakage across a surface having relatively low surface resistivity and operating under normal conditions of room temperature and humidity, comprising a dam of polystyrene or the like interposed in the electrical path for said currents, and means for holding said dam in sealed engagement therewith, comprising a cement having the characteristics of high volume resistance therethrough.

14. A vacuum tube including an envelope and electrodes therein, a lead from one of said electrodes extending in sealed relation through said envelope, a bushing of high surface resistance to electron creepage surrounding said lead at the point of emergence of the lead from the envelope and secured to the envelope by cement having high volume resistance to electron creepage, said bushing being hollow, said lead extending therethrough, and a coating of conducting material covering the outer surface of the envelope to the bushing.

15. In combination with a vacuum tube having an envelope of low surface resistance to electron flow and having an electrode element lead extending through the envelope, means for preventing surface current and voltage leakage to and from said lead across the outside of said envelope comprising a polystyrene or like bushing surrounding the lead, means for securing said bushing to said envelope comprising a cement having high volume resistance to electron flow, and an electrode cap for said lead.

16. A vacuum tube including an envelope and electrodes therein, a lead from one of said electrodes extending in sealed relation through said envelope, a polystyrene or like bushing surrounding said lead at the point of emergence from the envelope and secured to said envelope by De Khotinski cement, said bushing being hollow, the lead passing therethrough, and a coating of conducting material covering the outer surface of said envelope to the bushing.

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