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ELECTRIC DISCHARGE DEVICE STRUCTURE

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Fig. 1.

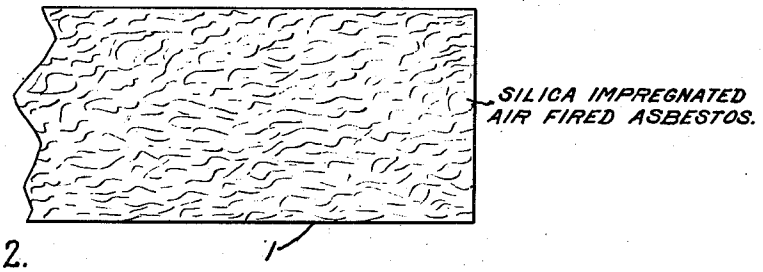


Fig. 2.

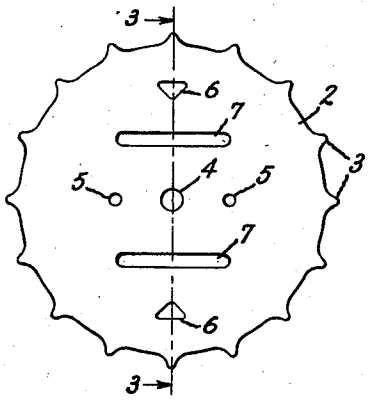


Fig. 3.

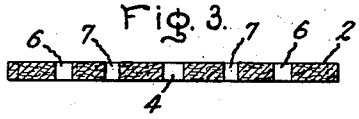
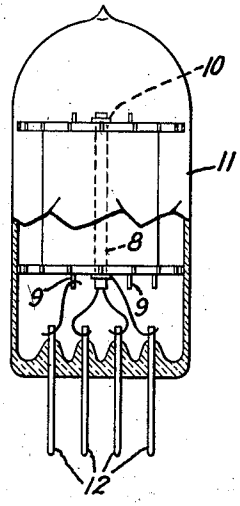


Fig. 4.



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ELECTRIC DISCHARGE DEVICE STRUCTURE

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3 Claims. (Cl. 313—261)

The present invention relates to improved insulating spacers for supporting the elements of electric discharge devices and methods of preparing the same.

In the manufacture of electron tubes, particularly those of the type commonly used in home radio and television receivers, it has been customary to support the electrodes or elements of the tube from one or more insulating disks or spacer members which are suitably apertured to receive portions of the tube elements. These spacers are also often dimensioned to engage the side walls of the tube envelope and thus provide the lateral support for the various electrode assemblies within the envelope. For many years mica has been used for these spacers. Mica, however, has certain shortcomings for this application and being a natural product is somewhat difficult to modify in its characteristics. For example, the mica sheets from which spacers are formed are obtained by splitting off the layers or strata of the mica. This renders it difficult to obtain spacers of uniform thickness. The mica is also somewhat rigid and has a very smooth surface. The rigidity, while lending support to the tube mount, in some cases introduces a rather severe problem with respect to vibration or microphonics. The smooth surface is also detrimental with respect to surface leakage. Foreign or contaminating material which becomes deposited on the insulating spacer during processing or life of the tube is much less apt to form a continuous path of low resistance on a rough surface insulator. Mica also is not as good a thermal insulator as would be desirable for supporting the cathode sleeve usually employed in receiving tubes.

As a result of the foregoing considerations, there has been a need for insulating spacer members with properties which might more readily be controlled and which would have superior characteristics particularly with respect to some of the more exacting requirements of present-day tube design.

In accordance with an important aspect of the present invention, an improved spacer is provided by specially treated asbestos which eliminates or minimizes many of the defects of other insulating materials such as mica.

It is another object of our invention to provide an insulating spacer for electron tubes having controllable mechanical properties such as rigidity.

It is a still further object of the present invention to provide a new and improved method of producing spacers for electron tubes.

As a starting material from which spacers embodying the present invention are prepared, asbestos sheet or asbestos containing up to ten per cent by weight of bentonite or other clay and rolled into a sheet may be used. The sheet material is of suitable thickness, for example, in the order of .007" to .030".

Asbestos sheet material, preferably containing a small percentage of bentonite, is further treated by impregnation with a suitable colloidal silica of which a number are available on the market or other stiffening material. Suitable materials include potassium silicate, sodium silicate

or aluminum phosphate. In a particular process, the impregnating material is colloidal silica resulting from partially hydrolyzing ethyl silicate with nitric acid. It is desirable that the hydrolyzed silica used be free of the halogens and accordingly it is desirable to avoid such acids as hydrochloric and hydrofluoric as the hydrolyzing acid. The colloidal silica may be produced by other known methods such as by removing the alkali ion from sodium or potassium silicate by passage over an ion exchange resin.

The impregnation may be carried out by known processes such as vacuum, pressure or floatation process. In a suitable floatation process, the sheets are floated in a vat containing a water solution of the silica, about 30% by weight, until wet spots appear on the surface. The material is then submerged to wet the outer surfaces and the sheets are air-dried at room temperature and then more completely dried at 250° F. If desired, the sheets may be calendered when damp to control the thickness of the material and also to provide a range of surface characteristics as desired. For example, surface contour roughness may be controlled by the rolling operation and also projections or ridges at desired places may be introduced at that time. This surface condition which is important with respect to surface electrical leakage will be described at more detail at a later point in the specification.

After the drying, the sheets are cut into strips and the strips are then air-fired to control the mechanical characteristics of the material. This air firing is a very important step in the preparation of spacers from the silicate impregnated bentonite containing asbestos. The change in properties with firing of the material may be attributed in part to a conversion of the ethyl or other silicate to silica and also to a conversion of the bentonite to a ceramic-like phase. The extent of the change and the resultant mechanical characteristic is determined by the time and temperature of the air firing, and may be varied over a substantial range. Useful air firing temperatures may fall within the range of 450° C. to 650° C. with the firing time varying from 15 minutes to 30 seconds, the longer time corresponding to the lower temperature and vice versa. A narrower and generally more useful air firing range includes temperatures from550° C. to 600° C. with firing times of 10 minutes to 3 minutes.

Since the thermal conductivity of the material is very low, only about one-half that of the ordinary mica, it is apparent that the higher temperatures and shorter times produce relatively great surface changes with much less change in the interior of the material.

By a proper balance of the above considerations, it is possible to obtain almost any desired degree of strength, stiffness or rigidity and the like to give the needed amount of support without introducing unnecessary brittleness in the material or diminishing its vibration damping properties.

The low thermal conductivity of the material offers another advantage over ordinary mica in that much less heat is conducted away from the cathode sleeve for a given area of contact. This means that either less heat is lost or additional thickness of supporting insulator may be employed.

The tendency of the insulated material to give off gas during normal operation of the tube in which it is used may also be controlled to some extent by the air firing step. In general, it may be said that to the extent that the surface of the material is converted to a hard or rigid ceramic like composition, the tendency to evolve gas decreases. For those tube types in which substantial metal is in contact or in very close proximity to the material a hardening of the spacer may be produced by raising the metal parts to an elevated temperature after assembly within an electric discharge device. This may

be accomplished to advantage during the outgasing of the metal parts which is usually carried on during exhaust. For this high temperature treatment, temperatures in excess of 900° C. may be employed. It will be appreciated, however, that the duration of the treatment is very short so that the effect on the insulator is largely a surface one.

Additional steps in the production of spacers embodying the present invention may be more readily explained by reference to the accompanying drawing in which Fig. 1 illustrates a sheet of silica-impregnated air-fired asbestos. Fig. 2 is a plan view of a spacer embodying the present invention, Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2, and Fig. 4 illustrates the application of spacers embodying this invention to a miniature type receiving tube.

Referring now to the drawing, Fig. 1 illustrates a sheet of asbestos, preferably of the type treated with bentonite and silica-impregnated and air-fired in accordance with the process steps previously described. The sheet in this form is ready for punching into the spacers. In Fig. 2 I have illustrated such a spacer suitable for use in a miniature type electric discharge device. The spacer 2 is in the form of a circular disk having peripherally extending teeth 3 for engagement with the inner wall of the tube envelope. The spacer is suitably punched to provide apertures for reception of extensions of the various electrodes and as illustrated is provided with a central opening 4 for a cathode sleeve, openings 5 for the side rods of a grid, and openings 6 for receiving extensions on ears of a plate cylinder. Elongate slots 7 may be punched in the spacers to break up the surface leakage paths between the openings for the anode supports and the openings for the remaining electrodes.

In Fig. 4 is shown an elevational view of a miniature tube assembly employing such spacers in a triode tube mount. As illustrated, the cathode sleeve 8, the grid side rods 9 and plate ears 10 extend through the openings 4, 5 and 6 respectively and the plate ears 10 are bent over to retain the assembly together. As illustrated, the spacers engage the inner wall of the envelope 11 to give lateral support to the mount. In accordance with usual practice, the mount is positioned axially of the envelope by means of the electrical connections with the various electrodes which are in turn connected with the various lead-in conductors and contact prongs designated by the numeral 12.

As will be well understood by those skilled in the art, the various components of the tube including the spacers are heated to an elevated temperature during exhaust of the tube. While in many cases it is possible for a tube embodying the spacers of our invention to be processed in the usual way, we have found that better tube performance may be obtained by additional processing to limit the evolution of gas from the spacers during operation of the tube. Easier degassing of the spacers may be obtained if they are sprayed with aluminum oxide suspended in a nitrocellulose lacquer after the air firing step previously described prior to the exhaust processing. In those cases where no aluminum oxide spray is used, somewhat better outgassing is obtained by a very short heating of the metal parts in contact with the spacers to a temperature in excess of 900° C. (for example 1000° C.). While both of the steps mentioned above may be used to advantage if difficulty in outgassing is experienced and there is a resulting decrease in emission of the tube, in many tube types it is possible to process the tubes in accordance with the usual exhaust schedule and without any treatment with the aluminum oxide. The aluminum oxide spray probably has two major affects, the first results from the thermal insulating properties of the oxide layer and the second is the water resistant properties of the nitrocellulose or other binder employed. The sprayed spacers accordingly absorb much less moisture during storage between the air firing step and exhaust of a complete tube.

It will be apparent from the foregoing that the present invention provides for an insulating spacer having controllable characteristics with respect to both its mechanical and electrical properties. In this way it offers a spacer material for electric discharge tubes which has numerous advantages over the natural material, mica which has been used almost exclusively prior to this invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electric discharge device comprising, an envelope, a plurality of electrode elements in said envelope, and an insulative spacer member supported in said envelope and having portions of said elements extending therethrough, thereby to support said elements in a desired fixed spacing, said spacer member comprising a sheet of silica impregnated asbestos having only the surface thereof rigidized by air-firing, said surface contacting said elements for maintaining said desired fixed spacing and said member having a relatively less rigid interior contacting said elements thereby to provide vibration damping of said electrodes.

2. An electric discharge device as in claim 1, wherein the spacer member comprises a sheet of silica impregnated clay containing air-fired asbestos.

3. An electric discharge device as in claim 1 wherein the spacer member includes a coating of aluminum oxide.

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