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MICROWAVE ENERGY WINDOWS WITH CONDUCTIVE COATING FOR DISSIPATING STATIC CHARGES

Filed Aug. 19, 1963 2 Sheets-Sheet 1

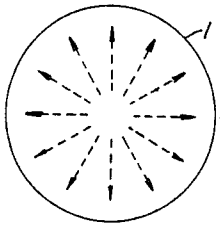

FIG. 1.

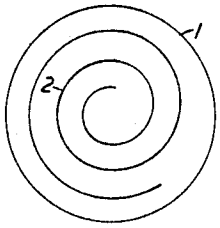

FIG. 2.

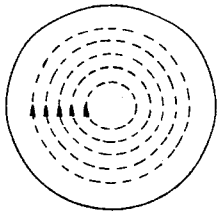

FIG. 3.

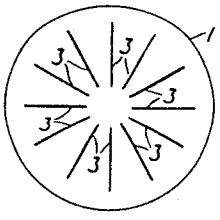

FIG. 4.

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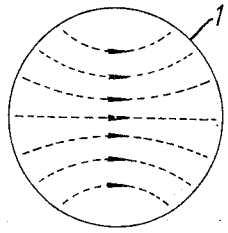

FIG. 5.

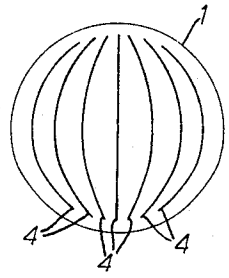

FIG. 6.

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MICROWAVE ENERGY WINDOWS WITH CONDUCTIVE COATING FOR DISSIPATING STATIC CHARGES

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Claims priority, application Great Britain, Oct. 1, 1962, 37,029/62
7 Claims. (Cl. 333—98)

This invention relates to mirowave energy windows for high power microwave waveguides and devices.

It is common practice to take microwave energy from an evacuated microwave generator such, for example, as a magnetron, by means of an output waveguide having a microwave window of suitable insulating material, usually glass, across it. The reliability of such windows, as at present known and in general use, leaves much to be desired and when such windows are used for the transmission of high powers at high frequencies, they sometimes fail by puncturing. Such puncturing may be caused by disruptive discharges produced because static electric charges build up on the insulating window surface. In fact the risk of puncturing by disruptive discharges of static electric charges on a microwave energy window sets an undesirable limit to the power and frequency at which such windows as are at present known can be safely used. The present invention seeks to overcome this difficulty and raise the limit.

According to this invention a microwave energy window of insulating material is provided on one or both of its surfaces with a thin resistive conductive coating shaped to form at least one conductor extending substantially perpendicularly to the direction of the high frequency electric field component in the plane of the window.

In the case of a circular window for microwave energy in the circular TM_{01} mode, where the electric field in the plane of the window is radial, the deposit or coating on one or both sides of the window should be of spiral shape. In the case of a circular window for microwave energy in the circular TE_{01} mode, where there is no radial component in the plane of the window, the deposit or coating on one or on both sides of the window should consist of a number of radial lines. The invention is, of course, not limited to its application to windows for microwave energy in the circular TM_{01} and circular TE_{01} modes. Thus, for example, in the case of microwave energy in the TE_{11} mode, the deposit or coating would be in lines perpendicular to the plane of electric polarisation.

The deposit or deposits or coating or coatings provided are such that the high frequency power dissipation thereof is small and an adequate high frequency breakdown voltage strength retained for the window. Among suitable materials for the coatings or deposits provided by this invention are colloidal graphite and metal which may be deposited by any known convenient suitable method, e.g., by painting or sputtering. In all cases the deposit or coating is arranged to form a conductor or conductors lying as nearly as possible perpendicular to the lines of the electric field in order to reduce, as much as possible, absorption of high frequency energy.

The invention is illustrated in and further explained in connection with the accompanying drawings which illustrate the invention as applied to windows for circularly sectioned waveguides. In the drawings, FIGURE 1 conventionally represents the electric field in the plane of a window of a circularly sectioned waveguide operating in the circular TM_{01} mode, and FIGURE 2 is a face view of a window in accordance with the invention for such a guide. FIGURE 3 similarly represents the electric field in the plane of a window of a circularly sectioned waveguide operating in the circular TE_{01} mode; FIGURE 4 is a face view of a window for use in this case; FIGURE 5 represents the electric field in the plane of a window of a circularly sectioned waveguide operating in the TE_{11} mode; and FIGURE 6 is a face view of a window for the guide of FIGURE 5.

Referring to FIGURE 1 the arrow-headed broken lines represent the electric field in a circularly sectioned waveguide **1** operating in the circular TM_{01} mode. In accordance with this invention the window is provided on either or both of its faces, as shown in FIGURE 2, with a thin spiral coating **2** of, for example, colloidal graphite or metal. A deposit on only one face of the window is shown in FIGURE 2.

In FIGURE 3 the arrow-headed lines represent the electric field of a guide **1** operating in the circular TE_{01} mode. For this case a deposit or coating **3** of radial lines is employed as shown in FIGURE 4. As in FIGURE 2, there may be coatings on either or both faces, a coating on only one face being shown.

In FIGURE 5, the arrow-headed broken lines represent the electric field of a guide **1** operating in the TE_{11} mode. For the latter case a deposit or coating **4** of lines perpendicular to the lines of the electric field is employed as shown in FIGURE 6. Again there may be coatings on either or both faces of the window, but FIGURE 6 shows a coating on only one face.

In general, in any particular case, the coatings, if provided on both faces of a window, will be identical, but this is not essential.

We claim:

1. A microwave energy window of insulating material having on at least one of its surfaces a thin resistive conductive coating shaped to form at least one conductor extending substantially perpendicularly to the direction of the high frequency electric field component in the plane of the window.

2. A window as claimed in claim **1** having a conductive coating on each of its surfaces.

3. A circular window in accordance with claim **1** for microwave energy in the circular TM_{01} mode, wherein said conductive coating is of spiral shape.

4. A window in accordance with claim **1** for microwave energy in the circular TE_{01} mode, wherein said conductive coating comprises a number of radial lines.

5. A window in accordance with claim **1** for microwave energy in the TE_{11} mode, wherein said conductive coating is in the form of lines perpendicular to the plane of electric polarisation.

6. A window as claimed in claim **1** wherein the coating material is graphite.

7. A window as claimed in claim **1** wherein the coating conductor is arranged to lie as nearly as possible perpendicular to the lines of the electric field.

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