Aug. 6, 1957 C. L. DAY 2,802,126

VACUUM TUBE ELEMENT

Filed Oct. 25, 1954



FIG.1

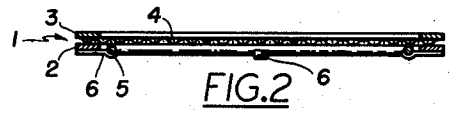


FIG.2

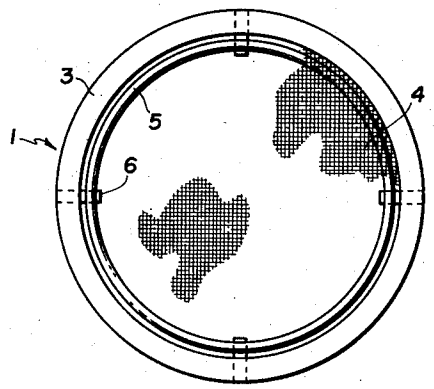


FIG.3

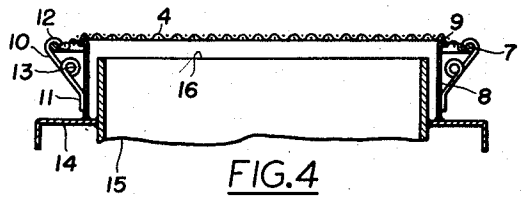


FIG.4

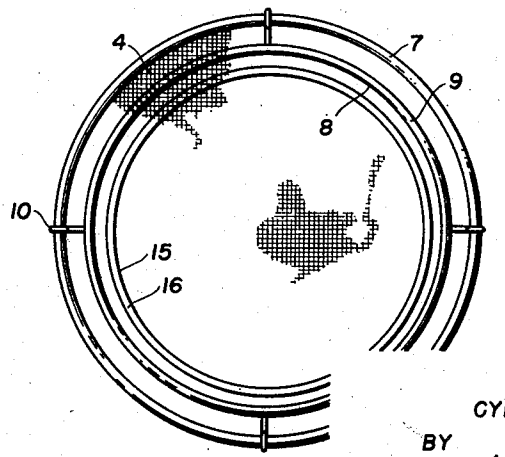


FIG.5

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VACUUM TUBE ELEMENT

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4 Claims. (Cl. 313—50)

The present invention relates to a vacuum tube element, and more particularly to grid constructions for use in controlling electron flow in a vacuum tube.

In certain camera and picture tubes, a fine mesh screen element which covers a relatively large area is used to control the flow of electrons between a cathode and target electrode. Typical tubes are found in Farnsworth et al. Patent No. 2,098,000, Farnsworth Patent No. 2,109,289, and Knight application Serial No. 361,655, filed June 15, 1953. The screen elements used in the tubes of the foregoing patents and application and similar tubes are conventionally supported on annular rings in such a manner that the grid material is formed into a straight, flat plane. Usually, these grids are made of screen material of extremely fine mesh, for example, 500 to 1,000 mesh size. By reason of this fine mesh, the material is extremely fragile, and the slightest applied force due to physical pressure or thermal expansion will cause the screen to flex, and in many instances to break. Furthermore, such material will bend under the influence of electrostatic fields, whereupon critical spacing in the vacuum tube between the grid and other tube elements is altered, thereby deleteriously affecting tube operation.

In accordance with this invention, grids made of either insulator or metallic material are so constructed as to be maintained straight and flat under all tube-operating conditions, and to possess such physical characteristics as will permit the screen material to expand or contract without causing screen breakage or interrupting the flatness thereof. This is accomplished by mounting the screen material on an annular frame, and stretching the material on the frame by means of a ring concentrically disposed adjacent the inner periphery of the frame. Springs of suitable design yieldably urge the stretching ring into contact with the screen material whereby the latter is tightened. Since the springs will yield under force, any contraction or expansion in the screens will be absorbed by the springs, thereby maintaining the screen material taut at all times.

An object of this invention is to provide a grid element for a vacuum tube wherein a flexible screen may be maintained taut under all conditions of tube operation.

Another object of this invention is to provide a grid element construction for a vacuum tube wherein means is provided for permitting the screen material to flex without disturbing the normal shape and contour thereof.

Other objects will become apparent as the description proceeds.

To the accomplishment of the above and related objects, the invention may be embodied in the forms illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that specific change may be made in the specific constructions illustrated and described, so long as the scope of the appended claims is not violated.

In the drawings:

Fig. 1 is a cross-sectional view of a grid element of this invention is unstretched condition;

Fig. 2 is a cross-section of an embodiment of this invention;

Fig. 3 is a plan view of the embodiment of Fig. 2;

Fig. 4 is a cross-sectional view of another embodiment of this invention as incorporated in a vacuum tube; and

Fig. 5 is a plan view of the embodiment of Fig. 4.

Referring to the drawings, and more particularly to Fig. 1, a supporting frame indicated generally by the reference numeral 1 is composed of two annular supporting frames 2 and 3, respectively, which clamp the peripheral edge of a suitable screen element 4 therebetween. In order to secure the screen 4 to the frame 1, the rings 2 and 3 are preferably welded together. As shown in the drawing, the screen 4 is loosely mounted in the frame 1, and in this condition is unsuitable for use in the average vacuum tube. This screen 4 may be composed of either insulating or conductive material, such as glass or metal, of extremely fine mesh size, such as 500 mesh. Because of such fineness, the screen is extremely flexible and must be handled with care in order to prevent breaking or tearing.

Referring now to Fig. 2, a stretching ring 5 is concentrically disposed adjacent the inner periphery of the lower frame 2 and is retained in such position by means of a plurality of flat springs 6 which are secured to the underside of frame 2. The inner ends of the springs 6 are curved slightly as shown to engage the stretching ring 5, and further are preformed to yieldably urge ring 5 upwardly into engagement with the screen 4. The point of contact of the ring 5 with the screen 4 is preferably contiguous with the inner periphery of the supporting frame 1.

By reason of the forceful engagement of the stretching ring 5 with the screen material 4, the latter is effectively stretched into a flat plane. Any thermal expansion or contraction or other forces which might cause the screen 4 to move are obviously absorbed by the springs 6, such that the screen 4 will at all times be maintained taut.

With reference to Figs. 4 and 5, like numerals will indicate like parts. In the embodiment of these figures, the screen 4 is welded to the underside of a metallic supporting ring 7 and is biased upwardly by means of a stretching sleeve 8 having a curved flange 9 for contacting the screen. Suitable hook springs 10 made of suitable spring wire are attached at one end 11 to the outer surface of the sleeve 8 as shown. The upper ends 12 are hook-shaped for engaging the ring 7 to urge the latter downwardly with respect to the sleeve 8. This serves to draw the screen 4 tightly over the curved flange 9 and maintains the screen flat. Preferably, each spring 10 is provided with a center loop 13 which is preformed to draw the two spring ends 11 and 12 toward each other.

In the vacuum tube structure shown in Fig. 4, the sleeve 8 constitutes a mounting support for the grid construction and is shown as being attached to a suitable annular support 14 by welding. This same annular support 14 carries an anode or cathode sleeve element 15 in spaced relationship with the screen 4, the spacing between the screen and the upper end 16 of the sleeve being critical and maintained constant throughout the extent thereof. Assuming the existence of electrostatic fields or other forces which tend to bend or warp the screen 4, such forces will be absorbed by the resiliency of the springs 10 for maintaining the screen 4 straight and flat. Thus, should the forces tend to contract the screen material to such an extent as to tear it, the springs 10 will flex sufficiently to allow for the contraction, and will thereby prevent any screen damage from occurring.

Yet, the screen will be maintained in its proper operating relationship with the other tube electrodes.

The importance of this invention is two-fold. In fabrication, it is usually necessary to heat treat the screen 4 to obtain the desired physical characteristics necessary for proper tube operation. Obviously, the resilient structure will permit expansion and contraction of the screen during heat treatment and will eliminate the usual tearing or rupturing which makes the screen unsuitable for use.

In actual practice, tearing or malformation of the screen material encountered under prior art techniques has been completely eliminated.

The second important aspect of the invention, which has been explained previously, permits the screen to accommodate forces imposed thereon by tube operation in such a manner that the screen is not damaged yet it is maintained in proper shape and space relationship for maximum efficiency of tube operation.

As is now apparent, this invention is particularly adaptable for use in the fabrication of relatively large plane grids which heretofore have been extremely tedious and costly to fabricate.

What is claimed is:

1. A grid element for a vacuum tube comprising rigid frame means having an open center, flexible material loosely mounted on said frame means, stretching means engaging said flexible material at a point radially spaced from said frame means, said frame means and said stretching means being telescopically movable and means operatively connected to said frame means and contacting said stretching means for urging it into engagement with said flexible material for tightening the latter on said frame means.

2. A grid element for a vacuum tube comprising rigid frame means having an open center, screen material loosely mounted on said frame means, a stretching support floatingly supported with respect to said frame means for slidable engagement with said screen material at a point radially spaced from said frame means, and

resilient means interconnecting said frame means and said support for yieldably urging said screen material into engagement with the latter, said engagement being sufficiently forceful to overcome screen looseness and to tighten the screen material on said frame means.

3. A grid element for a vacuum tube comprising an annular frame, screen material loosely carried by said frame and covering the opening thereof, a stretching ring concentrically supported inside said frame for slidable engagement with said screen material, there being radial space between said frame and said ring which is spanned by said screen material, and springs interconnecting said frame and said ring for yieldably urging said ring into engagement with said screen material, said springs exerting sufficient force to tighten said screen material on said frame.

4. A grid element for a vacuum tube comprising an annular frame, screen material loosely carried by said frame and covering the opening thereof, a stretching ring concentrically supported inside said frame for engagement with said screen material, there being radial spaced between said frame and said ring which is spanned by said frame material, and springs interconnecting said frame and said ring for yieldably urging said ring into engagement with said screen material, said springs exerting sufficient force to tighten said screen material on said frame, said stretching ring comprising a sleeve which contacts said screen material radially inside the inner periphery of said frame, said springs being attached to the outer surface of said sleeve and tending to telescope said frame over said sleeve in a direction to tighten said screen material.

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