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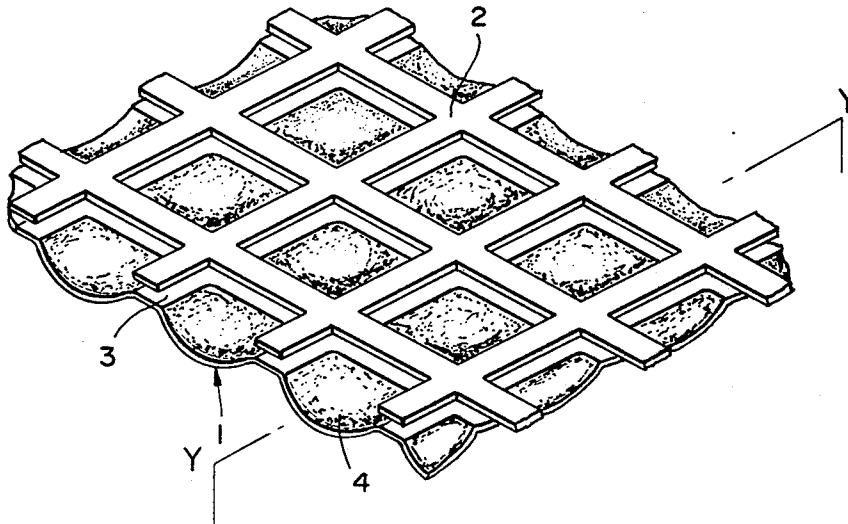
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[54] **ELECTRON TUBE WITH MESH-TYPE CATHODE
 HAVING EMISSIVE PORTIONS BETWEEN CROSS
 STRIPS**
6 Claims, 4 Drawing Figs.

[52] U.S. Cl..... **313/310,**
313/356, 313/353, 313/346
 [51] Int. Cl..... **H01j 1/16,**
H01j 19/10
 [50] Field of Search..... **313/54,**
217, 218, 211, 212, 213, 310, 341, 353, 346, 356

ABSTRACT: A cathode structure of substantially uniform thickness exhibiting reduced heating time in an electron tube having a mesh grid, the cathode comprising a mesh portion consisting of substantially flat cross-strips and a number of depressed portions formed between the cross-strips, the depressed portions being coated with an electronic emissive material.



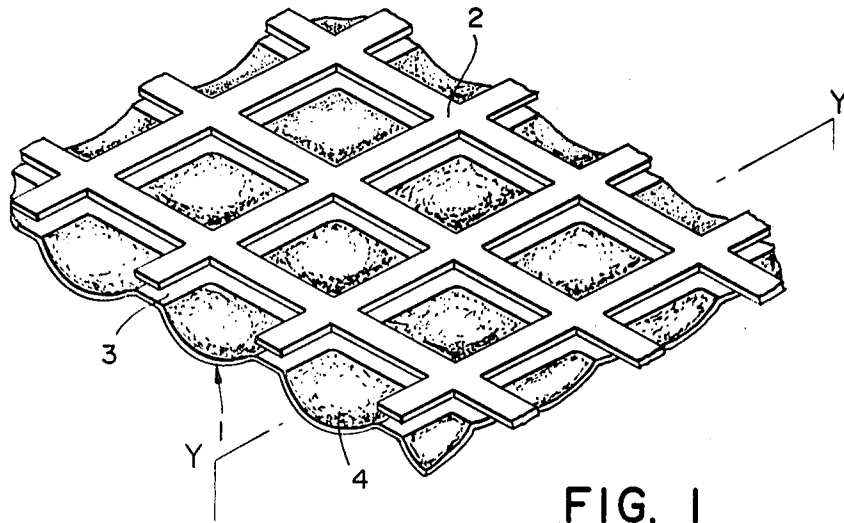


FIG. 1

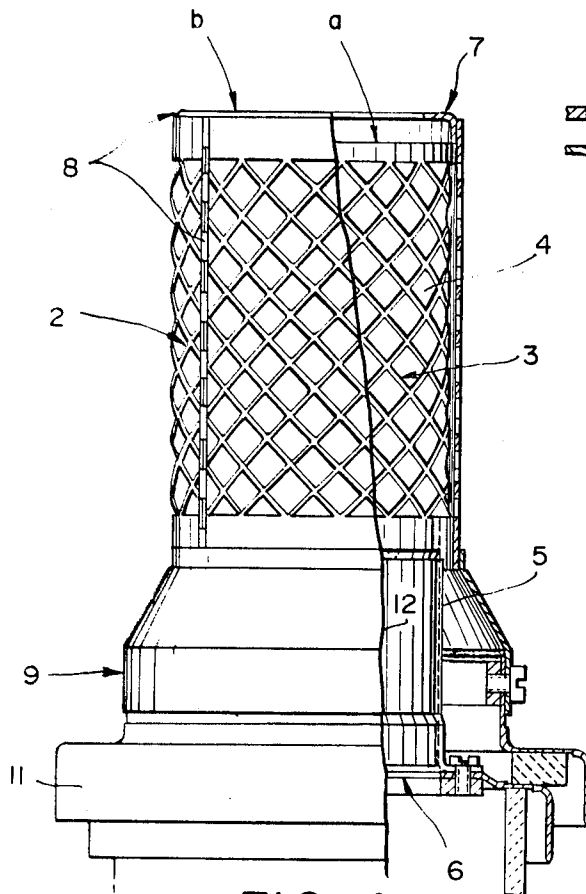


FIG. 4

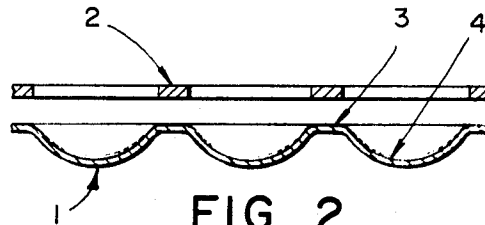


FIG. 2

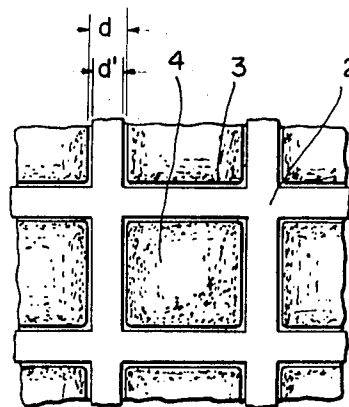


FIG. 3

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ELECTRON TUBE WITH MESH-TYPE CATHODE HAVING EMISSIVE PORTIONS BETWEEN CROSS STRIPS

This invention relates to improvements in electron tubes and more particularly to improvements in pulse transmitting triodes or tetrodes having mesh grids for diminishing the exciting power and increasing the effective cathode area.

In general, the mass and the thermal capacity of a thicker cathode plate are greater than those of a thinner cathode plate, if both cathode plates have the same surface area. After applying a voltage to the cathode of an electron tube it takes a certain time until it reaches the operating temperature. This time is called heating time. An increase of the thermal capacity of the cathode results in an increase of said heating time. However, it is desirable that the heating time be kept as short as possible. Compared with a directly heated tube, a heater-type tube has the disadvantage that the heating time is long. Thus, the use of a thick cathode base metal plate results in enhancing the disadvantage.

Therefore, the main object of the invention is to provide a novel cathode construction which exhibits reduced heating time and which is relatively simple to manufacture.

SUMMARY OF THE INVENTION

According to this invention, a electron tube having a mesh grid structure is provided with a cathode which comprises a base metal plate of substantially uniform thickness which includes a mesh portion consisting of a plurality of substantially flat cross-strips and a plurality of depressed portions formed between the cathode cross-strips. Further provided is an electron emissive material (i.e. a thermionic material) coating the depressed portions of the cathode.

In a preferred embodiment the grid is mounted spaced from the cathode, the cross-strips of the grid projecting upon the cross-strips of the cathode. In this preferred embodiment, the width of the cathode cross-strips is at least as great as the width of the cross-strips of the grid.

The above and other objects of this invention will become more apparent by reference to the following description of a preferred embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is perspective view of a portion of a cathode and grid structure of an electron tube according to this invention;

FIG. 2 is a sectional view taken along the lines y-y or x-x of FIG. 1;

FIG. 3 is a partial side view of the cathode and grid structure of FIG. 1; and

FIG. 4 is a side view, partly broken away, of one embodiment of an electron tube according to this invention.

Referring to FIGS. 1 and 2, there is shown a typical cathode and grid structure according to this invention. The grid 2 is a mesh which may be fabricated from a metal sheet by means of a photoengraving process or a discharge process, for example. The cathode 1 comprises hollow portions 4 and cross-strips 3. The mesh grid 2 and the cathode 1 are arranged maintaining the necessary gap therebetween, depending upon the particular application, and the cross-strips of the mesh grid 2 are mounted opposed to the cross-strips 3 of the cathode 1. Thus, when the grid 2 is projected onto the cathode 1, the projection of the cross-strips of the grid 2 overlap the cross-strips of the cathode 1. This is more clearly seen with reference to FIG. 3.

With reference to FIG. 3, d represents the width of the strips 3 and d' represents the width of the strips of the grid 2. For the best operation of an electron tube according to this invention, the parameters d and d' must be maintained substantially equal.

When the above type of grid and cathode structure is utilized in a pulse transmitting tube, a tube of high linearity and large effective cathode area having reduced heating time results. The cathode and grid structure shown in FIGS. 1 through 3 may be manufactured in the following manner. The cathode base metal plate 1, comprised of material such as

nickel plate or the like, is formed by a pressing process and consists of hollow portions 4 and cross-strips 3, the cross-strips 3 being equal to or wider than the projection of the cross-strips of the mesh grid 2 onto the cathode 1. Alternatively, the cathode 1 may be press-formed so that the hollowed-out portions 4 are flat portions and the cross-strips 3 are formed as convex portions.

In order to obtain high linearity in the input-output electrical characteristics in an electron tube, the mesh structure 2 of the grid must be made as fine as possible. But, it is very difficult to produce such a fine mating cathode structure by the above described press forming method. However this problem can be solved by utilizing a hydroforming process in which a female mold is made by a photoengraving process and an elastic film is used as the male mold. The thin cathode plate 1 is set between the male and female molds and is formed by means of oil pressure which is applied to the molds. The thus formed cathode element 1 may be used as a plate or may be rolled up to form a cylindrical electrode for an electron tube. The above described hydroforming process is well known in the art, and a more detailed description thereof is deemed unnecessary for a proper understanding of this invention. Also, it should be clear that any other well-known type of manufacturing process may be used to form a fine cathode structure according to this invention.

After the cathode structure is formed, the surface thereof is coated with an electron emission material. The surface is then wiped off and the electronic emissive material remains only in the hollowed-out portions 4 which are shown in detail in FIGS. 1 and 2. When the cathode 1 and the grid 2 are placed in a tube structure, the uncoated cross-strips 3 of the cathode 1 are overlapped with the grid mesh 2, the proper spacing being maintained therebetween. The electron radiating part 4 is concave and is coated with the electron emissive material. When the grid potential is more positive than the cathode potential, little current flows. The apparent cathode area is relatively large and very good linearity is obtained. Since the cathode is formed from a relatively thin material, an electron tube of good linearity and having a small thermal capacity (and therefore short heating time) is obtained.

Referring to FIG. 4, there are shown the major constituents of an embodiment of an electron tube according to this invention. In this embodiment, the electrodes are cylindrically shaped. A cylindrical cathode a comprises substantially square hollowed-out portions 4 and cross-strips 3. The cathode a may be a fabricated as a plate and then formed in a cylinder as shown in FIG. 4. The cylindrical cathode a is mounted on a flange 6 by means of a member 5. The flange 6 is mounted to the stem 11 which is partially shown for purposes of illustration only. The heater, which is not shown in FIG. 4, is arranged in the cathode cylinder a .

A cylindrical grid b is provided which comprises a mesh grid 2 and a cap 7. The grid b surrounds the cylindrical cathode a . The cylindrical grid b comprises a mesh grid 2 which may be manufactured from a metal sheet by photoetching or the like, both ends of the thus formed mesh grid being connected to one another by solder 8, or the like, to form a cylinder. A cap 7 is then mounted on the mesh cylinder by means of solder 8 of the like. The grid b is mounted to the stem 11 by means of element 9. Thus, a tube is provided which comprises a cylindrical cathode a mounted to the stem, the cross-strips 3 of the cylindrical cathode being completely opposed to the cross-strips of the mesh grid 2. In FIG. 4, the cathode a is shown on the right-hand side of the line 12 and the grid structure b is shown on the left-hand side of the line 12.

It is pointed out that in any type of construction of an electron tube according to this invention, the surface of the grid 2 may be surface treated in a manner well known in the art to provide improved operation of the tube and improved emission of primary and secondary electrons. Also, a second grid structure may be arranged surrounding the first grid to provide a tetrode electron tube.

In the embodiment shown in FIG. 4, the voids of the mesh grid 2 may be formed in a rhombic configuration in the expanded state of the grid if the hollow portions 4 of the cathode 1 are regular squares. This is due to the fact that the cathode and the grid are cylindrically shaped.

It will be obvious to those skilled in the art that many modifications are possible in structure, arrangement, proportion, and materials, used in the practice of this invention which are particularly adapted for specific environments and operating requirements, without departing from the inventive concept herein disclosed.

We claim:

1. In an electron tube having a mesh grid structure (2), a cathode comprising:
a base metal plate (1) of substantially uniform thickness including a mesh type portion consisting of a plurality of cross-strips (3) and a plurality of depressed portions (4) formed between said cathode cross-strips (3); and

electronic emissive material coating only said depressed portions (4).

2. The tube defined in claim 1 wherein the width of said cathode cross-strips (3) is at least as great as the width of the cross-strips which comprise said mesh grid (2).

3. The tube defined in any one of claims 1 and 2 wherein said grid mesh (2) is spaced from said cathode structure, the cross-strips of said grid projecting over the cross-strips of said grid projecting over the cross-strips (3) of said cathode.

4. The tube defined in any one of claims 1, 2 and 3 wherein said grid and cathode structures are cylindrical.

5. The tube defined in claim 4 wherein said cylindrical cathode structure is mounted within and coaxial with said cylindrical grid structure.

6. The tube defined in claim 1 wherein said cathode cross-strips (3) are substantially flat.

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