June 8, 1943. E. F. STAVER 2,321,259

ONE-PIECE SHIELD FOR ELECTRON EMISSION TUBES

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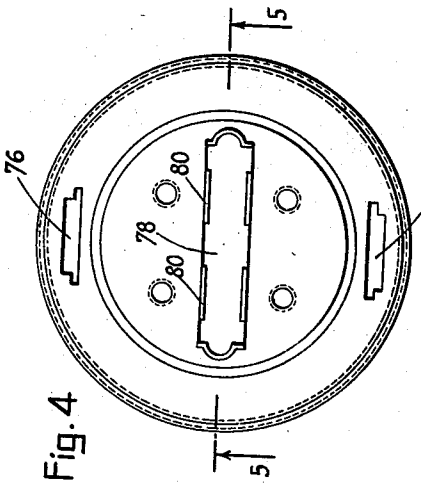


Fig. 4

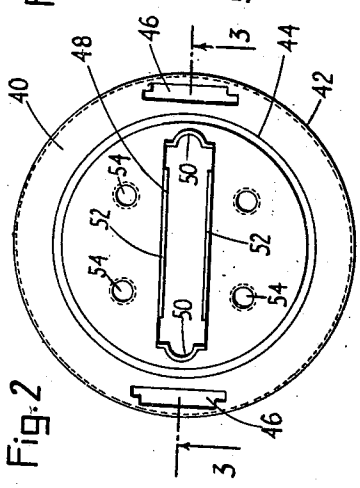


Fig. 2

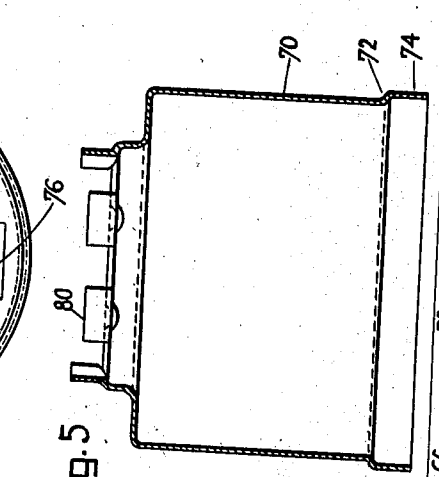


Fig. 5

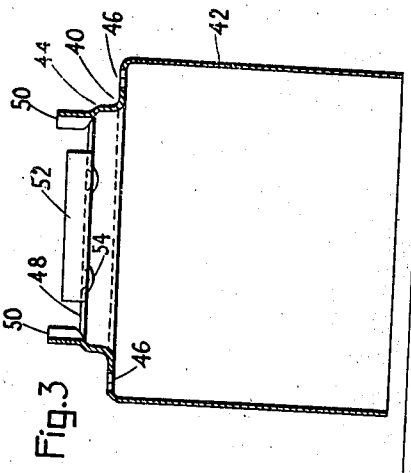


Fig. 3

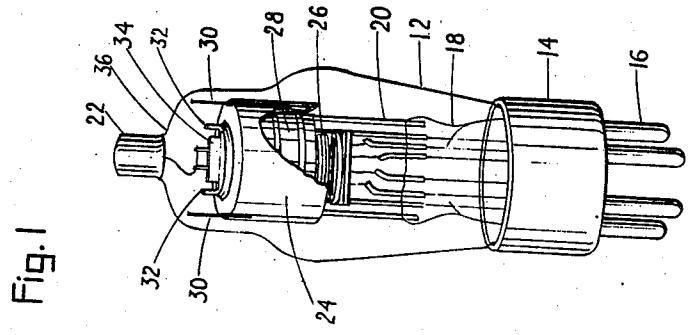


Fig. 1

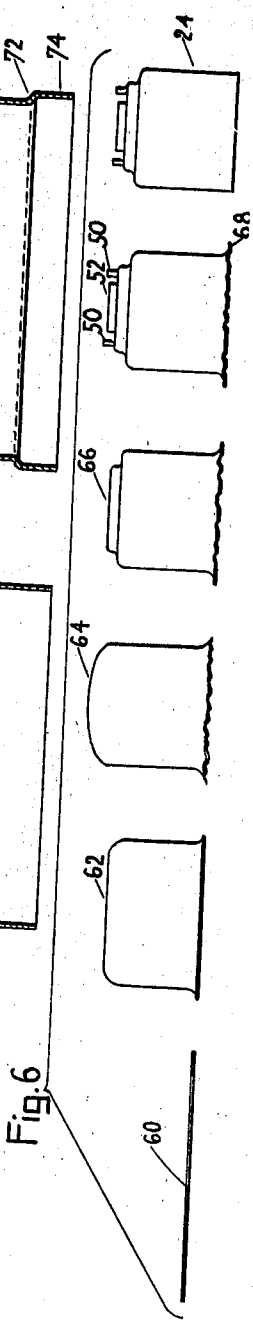


Fig. 6

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ONE-PIECE SHIELD FOR ELECTRON EMISSION TUBES

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Application August 4, 1939, Serial No. 288,335

2 Claims. (Cl. 250—27.5)

This invention relates to electron emission tubes, and more particularly to a screen or shield electrode therefor.

The primary object of the present invention is to generally improve vacuum tubes, and more particularly the screen or shield electrode for such tubes. A more particular object is to avoid the use of folds and seams in which dirt, impurities and lubricants may be trapped, and from which they are difficult to remove. Another object is to provide an electrode having improved electrical and magnetic shielding properties.

Further objects are to provide a shield characterized by increased rigidity and accuracy of shaping and dimension, thus avoiding accidental short circuits to the plate or anode of the tube. Other objects are to improve the appearance and decrease the cost of manufacture of the electrode by reducing the number of operations and eliminating assembly operations, and making it possible to make the complete electrode in a single machine. Still further economy may be had by making it feasible to use sheet steel instead of nickel or nickel plated steel for the electrode. Still another object is to provide an electrode having a more uniform path for heavy currents, such as are induced during bombardment of the tube, thus producing more uniform heating and avoiding warping of the electrode during bombardment. Another object is to provide an electrode which reduces or minimizes the likelihood of arcing through the glass during bombardment.

To the accomplishment of the foregoing, and such other objects as may hereinafter appear, my invention consists in the electrode and method of making the same, and their relation one to the other, as hereinafter are more particularly described in the specification, and sought to be defined in the claims. The specification is accompanied by drawing, in which:

Fig. 1 illustrates a tube embodying the screen or shield of my invention, the shield being partially cut away to expose the anode of the tube;

Fig. 2 is a plan view of one preferred form of shield embodying features of my invention;

Fig. 3 is a section taken in the plane of the line 3—3 of Fig. 2;

Fig. 4 is a plan view of a modified form of shield;

Fig. 5 is a section taken in the plane of the line 5—5 of Fig. 4; and

Fig. 6 schematically illustrates successive stages in the manufacture of my improved shield.

Referring to the drawing, and more particularly Fig. 1, I there show a conventional radio tube comprising evacuated glass envelope 12 supported in a base 14 having a ring of prongs 16 to be received in a mating socket. The glass envelope 12 is in this case provided with a re-entrant stem 18 holding a series of support wires and connecting wires 20 for the tube electrodes. In the particular tube here shown, an additional connection is taken at the top of the tube by way of cap 22.

The screen or shield of the present invention is indicated at 24. It is partially cut away to expose other electrodes in the tube, such as the grid 26 and the plate or anode 28. The shield 24 comprises a top wall and a side wall, and is open at the bottom. It receives small mica supports or spacers sometimes called snubbers 30 which are dimensioned to bear against the upper or crown portion of the tube envelope. The shield is supported by a pair of support wires welded thereto at 32. The shield is provided with small side plates 34 which help shield the conductors 36 leading to the grid of the tube.

Referring now to Figs. 2 and 3, it will be seen that the shield comprises a top wall 40 and a side wall 42. Ordinarily, the latter is cylindrical and this, while preferable, is not essential. It is important to observe that in the present shield the top wall and side wall are made of a single piece of metal; that is, the shield is a one piece shield. It will also be observed that the side wall 42 is solid or imperforate. The top wall is stepped at 44. The lower step is slotted at 46 with so-called T slots which are adapted to receive the mica snubbers 30 previously referred to. The upper step or top of the shield is slotted at 48. A part of the material struck from slot 48 is turned upwardly at 50, and appropriately channeled to receive the upper ends of a pair of support wires which are welded to the upturned parts or ears 50. The remainder of the material from slot 48 is turned upwardly to form side flanges or shield walls 52 which are not essential, but which are commonly employed to additionally shield the lead wires extending to the grid of the tube.

A horizontal mica washer or spacer is commonly inserted directly beneath the top wall of the shield. The top wall is indented at 54, thus forming dots or spacers which hold the mica washer from direct full surface contact. The resulting space between the shield and the washer is desirable, particularly during bombardment of the tube.

The method of manufacture of the one-piece electrode is schematically illustrated in Fig. 6. It is made in successive stages in a single main

die. The sheet material is fed in strip form to the die, and first a circular disc of metal is cut therefrom as is indicated at 60. This is next drawn to shallow cup shape, as is indicated at 62. The drawing operation proceeds further to produce a deeper cup shape, as in 64. The top of the shield is then stepped, as is indicated at 66, following which the top wall is further operated upon to produce the T slots for the mica snubbers, and to produce the ears 50 and walls 52. Finally, the comparatively rough creased residue or edge 68 at the open end of the shield is trimmed away leaving the finished shield 24.

It will be understood that minor modifications and changes in the design of the shield may be made without changing the essential novelty of the present shield and its method of manufacture out of one piece of material. For example, in Figs. 4 and 5, I show a modified shield in which the lower edge of the side wall 70 is stepped outwardly somewhat at 72 to provide a larger diameter skirt or flange 74. The object of this is to further stiffen the cylindrical wall 70 against deformation in the event of accidental mishandling or abuse. In Fig. 4, it will be seen that the T slots 76 for the mica snubbers are disposed at the sides of the main slot 78, instead of at the ends thereof, as in Fig. 2. Also the side shield walls 80 have been cut away at the center to provide four short walls, two at each grid support wire, instead of two long walls, as in Fig. 2. These and various other changes may be made to meet the requirements of the tube manufacturer. Sometimes there may be more than two slots for the mica snubbers. In some cases, two or more longitudinal channels may be desired on the interior or exterior of the cylindrical wall in order to receive support wires running directly to the cylindrical wall of the shield. The side wall need not be cylindrical, although it is usually so shaped. The side wall may be perforate or protruded, although it is preferably made solid. The design of the fittings at the top for receiving the spacers, and the support wires, etc., may be varied in accordance with the requirements of the individual tube manufacturer.

It is believed that the construction and method of manufacture of my improved shield will be apparent from the foregoing detailed description thereof. In order to understand the advantages of the invention, it is necessary to keep in mind the construction heretofore used. It was heretofore the practice to make a separate side wall which was rolled to shape, the ends being secured by suitable interlocking seams. The top wall was made separately with a channeled or beaded edge into which the upper edge of the side wall was secured by appropriate clamping or seaming methods. The resulting assembled shield was characterized by various folds and seams in which dirt, impurities and lubricants were trapped. These were difficult to remove even by strenuous cleaning of the parts. If allowed to remain present during bombardment, they formed gases which were left inside the tube. The new shield is devoid of such folds and seams, and is readily cleaned.

In fact, it is possible to make the shield of unplated steel, using an oil film for protection, thus making the shield very inexpensive. I may explain that tube parts were originally made of nickel, and more recently, for the sake of economy, have been made of nickel plated steel. However, even nickel plating costs money, though less than the use of solid nickel. Of course, the present shield may also be made of solid nickel or nickel plated steel. In the latter case the strip stock may be nickel plated, or the shield may be made of unplated cold-rolled steel which is then plated after completion of the shield. The latter procedure is preferable because there are then no exposed edges which remain unprotected, but either procedure may be successfully followed.

With the present invention, however, the shield may, if desired, be left with no plating at all. In such case the steel shield has a heavy oil film intentionally placed thereon to protect it against rust. Because of my new one piece construction, this oil film is safe to use because it is readily removed by appropriate cleaning methods just before using the shield in the tube electrode assembly.

In the prior types of assembled shield the conductivity between the parts of the shield may vary from point to point. In the present shield, the structure is integral and the conductivity is uniform throughout. During bombardment, the heavy induced currents flow uniformly through the shield structure, thus leading to uniform heating and avoiding warping with consequent possibility of short circuits to the anode or other parts of the tube.

Furthermore, the uniform conductivity throughout the shield results in a better shielding effect, both electrically and also magnetically. The latter advantage applies, of course, when using a permeable or ferrous material, there being a solid path for the magnetic flux.

The one-piece shield may be made of heavier metal at equal or lower cost than the usual perforate assembled shield, and is stronger and more rigid. It better withstands handling and damage and avoids accidental short circuits resulting from deformation. The shield, as manufactured, is more accurate in dimension and in shape. It is improved in appearance, for it avoids the ragged appearance resulting from clenching or seaming perforated or protruded metal.

The cost of manufacture is reduced even when using nickel plated metal, for the number of operations is greatly reduced. There is no need to make and assemble separate parts. The complete shield is made in a single machine without any extra handling on the part of operators.

During bombardment a high potential is applied to the screen, and if the apparatus surrounding the tube has metal parts near the glass, there is a tendency for electricity to arc over toward such metal parts and through the glass with possible puncturing of the glass. This arcing is facilitated by the existence of points or ragged edges, and here again the solid shield has an advantage over protruded metal, and the one piece shield has an advantage over an assembled shield.

It will be apparent that while I have shown and described my invention in several preferred forms, many changes and modifications may be made without departing from the spirit of the invention sought to be defined in the following claims.

I claim:

1. A shield for the electrodes of an electron emission tube, said shield comprising a single piece of sheet metal forming a top wall and a cylindrical side wall, said top wall being upwardly annularly stepped and provided with conventional slots and bent tabs of metal for support wires and spacers, said side wall being smooth, continuous and imperforate, said stepped top wall and side wall being formed integrally out of a single piece

of sheet metal and being joined by a smooth seamless joint, the step in said top wall also being formed with smooth seamless joints.

2. A shield for the electrodes of an electron emission tube, said shield comprising a single piece of sheet metal forming a top wall and a cylindrical side wall, said top wall being upwardly annularly stepped and provided with conventional slots and bent tabs of metal for support wires and spacers, said side wall being smooth, continuous and imperforate, and being annularly stepped outwardly to a larger diameter near its open bottom periphery to stiffen the same, the open bottom periphery having the maximum diameter of the electrode, said stepped top wall and side wall being formed integrally out of a single piece of sheet metal and being joined by a smooth seamless joint, the steps in said top and side walls also being formed with smooth seamless joints, and being continuously circular.

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