

Feb. 14, 1967

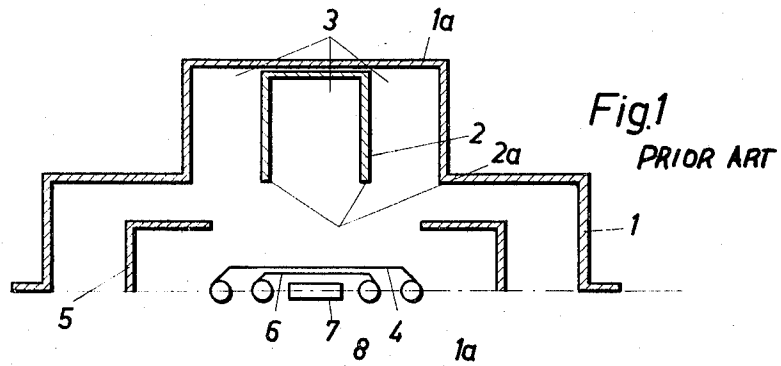
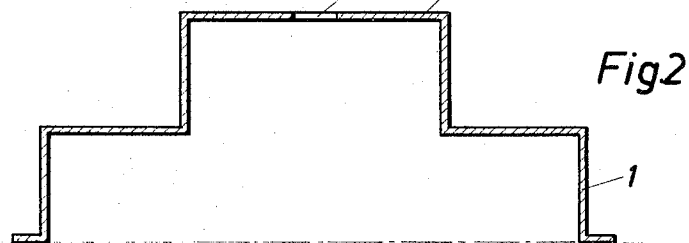
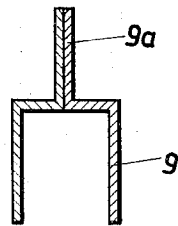
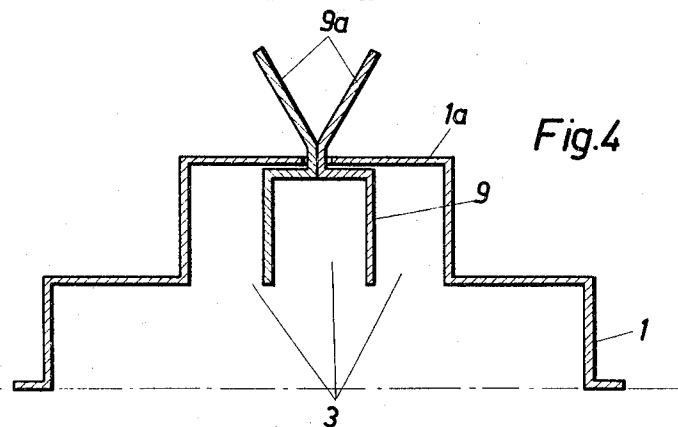
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3,304,453

PLURAL CHAMBER ANODE WITH RADIATION COOLING MEANS

Filed Dec. 18, 1964

3 Sheets-Sheet 1



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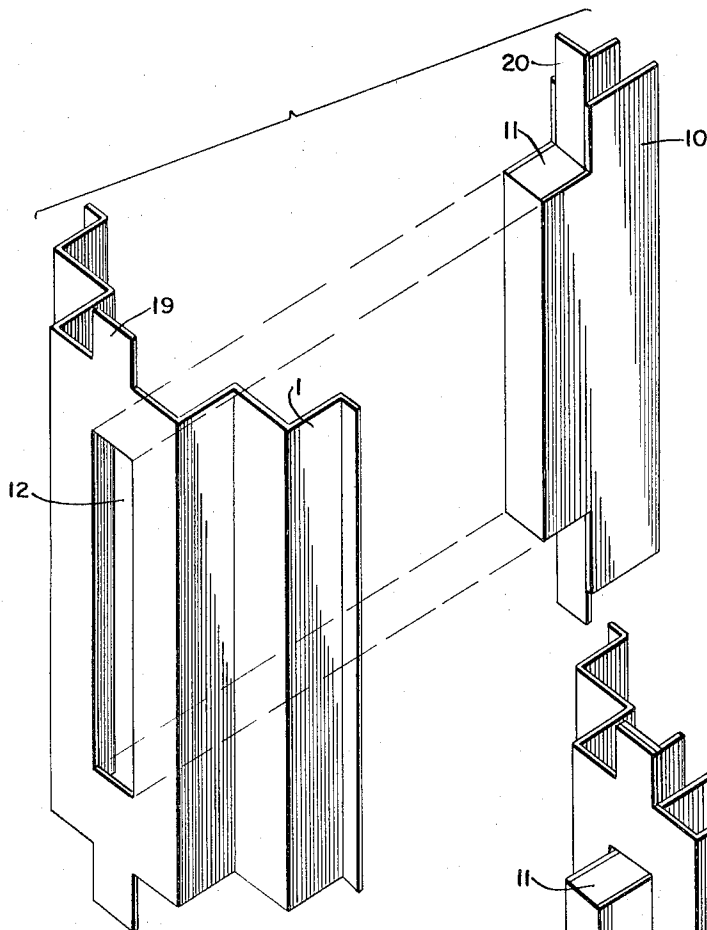


FIG. 5.

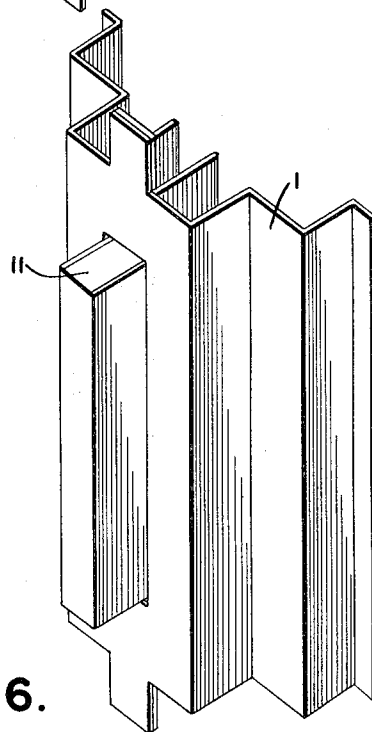


FIG. 6.

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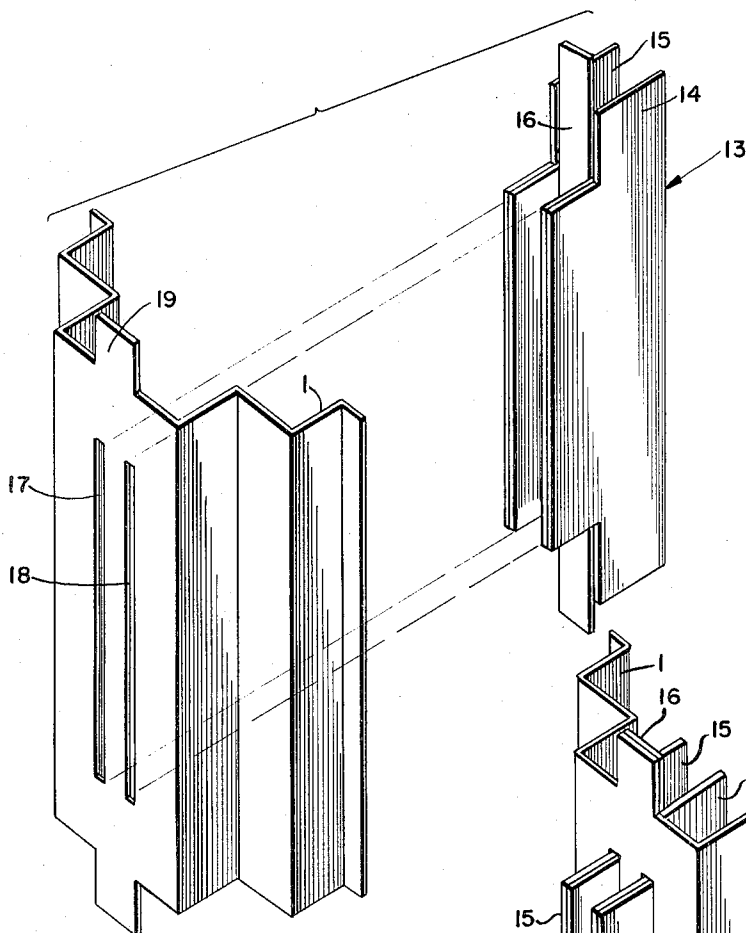


FIG. 7.

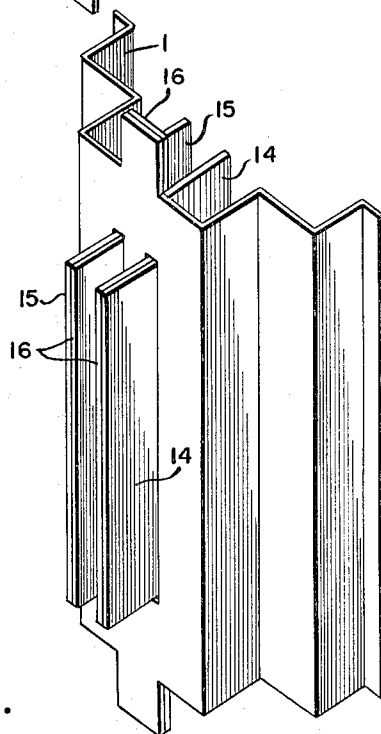


FIG. 8.

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PLURAL CHAMBER ANODE WITH RADIATION COOLING MEANS

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T 25,347

11 Claims. (Cl. 313—40)

The present invention relates to electric discharge tubes, and, more particularly, to an anode for electric discharge tubes having an active surface which extends substantially parallel to the plane of the grid, and which is divided by an insert in a chamber-like manner to form chambers, the open ends of which face the grid (or grids). Such anodes are generally termed "chamber anodes."

When unfavorable operating conditions exist in a tube, such a chamber anode may be used for example to reduce the effect of secondary electrons produced at the anode by electron bombardment, upon the grid situated in front of the anode. Such conditions exist, for example, in a pentode which is used for the line scan in a television receiver. In such a circuit, this tube is driven up to the knee in the anode-voltage characteristic curve. With such operation, the anode voltage drops markedly below the value of the suppressor grid, allowing an increased number of secondary electrons to pass from the anode to the screen grid. Moreover, Barkhausen-Kurz oscillations can easily occur in this mode of operation.

If a chamber anode is used, the walls of the chamber absorb the secondary electrons, thus preventing them from reaching the screen grid. However, this absorption generates heat in the walls of the chamber anode which must be dissipated, either by conduction or radiation. Since economic considerations dictate that the insert which forms the chambers is fastened to the anode by processes which result in low heat conduction bonds, conduction does not occur at a high enough rate to prevent the material forming the chamber walls from over-heating.

It is an object of the present invention to provide a chamber anode construction which overcomes the problems encountered in prior art structures.

It is a further object of the present invention to provide a chamber anode for electric discharge tubes in which the anode insert forming the chamber walls has portions extending outside the anode which are of sufficient area to cool the anode by radiation.

These objects and others are achieved according to the present invention by providing in an electric discharge tube having grid means defining a grid plane, a chamber anode comprising an anode member having an active surface disposed substantially parallel to and facing the grid plane, insert means arranged in the anode member and extending from the active surface thereof and facing toward the grid plane for dividing the interior of the chamber anode into a plurality of chambers and radiation means arranged in heat conducting relationship with the insert means and disposed exteriorly of the chamber anode so as to radiate heat from the insert means.

The heat developing in the walls of the insert member is thus transferred by conduction to the parts situated outside of the anode, and then radiated from these parts. The means securing the insert member to the anode no longer plays any part in this transfer, since the high heat-transfer resistance of this means is no longer in the path of the heat flow from the insert member, in the construction of the invention.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

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FIGURE 1 is a cross-sectional view of the elements of an electric discharge tube having a chamber anode, of the type used prior to the present invention.

FIGURE 2 is a cross-sectional view of a chamber anode for electric discharge tubes, as taught by the present invention.

FIGURES 3 and 4 are cross-sectional views illustrating insert members which form the chambers in the anode, according to the present invention.

FIGURES 5 and 6 are perspective views of a further embodiment of a chamber anode constructed according to the present invention.

FIGURES 7 and 8 are perspective views of still another embodiment of the chamber anode according to the present invention.

As shown in FIGURE 1, in prior art tubes with chamber anodes, that part of the wall of the anode 1 that is situated opposite the grid wires is set back a distance so that a recess 1a is formed. By inserting a U-shaped insert 2, the recess 1a is divided into three chambers 3, which are open at the side facing the screen grid 4 and the suppressor grid 5. The electrons coming from the cathode 7 through the control grid 6 can therefore pass into the chambers 3 where they release secondary electrons. These secondary electrons are, however, largely absorbed by the walls of the chambers 3 and can no longer reach the screen grid. The effect of the chamber anode depends on the number of chambers and their depth.

Due to the electrons impinging on the anode 1, the walls of the chambers 3 are heated, particularly the end faces 2a of the insert 2. For economic reasons, insert 2 generally is fastened to the actual anode member 1 by means of a few stamped out lugs which are secured by spot-welding. As a result, however, extremely poor heat transfer is obtained for the heat developing in the walls of the insert member 2 and flowing to the actual anode member 1. The heat developing in the walls of insert member 2 can therefore substantially only be removed from these walls by radiation in the interior of the tube system.

It would admittedly be possible to connect the insert member 2 to the anode member 1 by soldering; however, this would be too expensive and is therefore rejected for economic reasons.

The invention will be explained with reference to the several exemplary embodiments illustrated in FIGURES 2 through 10.

In the embodiment shown in FIGURES 2 through 4, a slot 8 is made in the middle of the recess 1a of the anode 1. As FIGURE 2 shows, the shape of the anode 1 remains otherwise unaltered. The width of the slot 8 depends on the thickness of the material of insert member 9, shown in FIGURE 3. This member 9 is bent into the shape shown and may either be made in one piece, or may include two parts. As a result, the U-shaped member described above for the formation of the chambers is obtained, but with the difference that there is a lug 9a on the part 9 thus formed. This lug 9a is pushed through the slot 8 in the recess 1a in anode 1 until the part 9 rests on the bottom of the recess 1a in anode 1. After this, member 9 is secured to the anode 1. The completed arrangement has the shape shown in FIGURE 4. The lug 9a then projects to the outside and radiates the heat transferred by conduction from the walls of the part 9. In order to increase the radiation of the lug 9a projecting to the outside still further, the two adjacent sheets of which it consists may be bent apart along their extensions away from anode member 1 projecting through the slot, as shown in FIGURE 4. The operation of the arrangement shown in FIGURE 4 as a chamber anode is not affected thereby.

If separation of the two parts of the lug 9a as illustrated

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in FIGURE 4 is not required, that is to say, if the insert member is left in the form illustrated in FIGURE 3, then this insert member may be produced from a single piece of sheet metal by appropriate bending. Where the members 9a are separated as shown in FIGURE 4, the insert member 9 may be produced from two parts which are, for instance, welded together at the common connecting point. The construction shown in FIGURE 4 has the advantage that the heat radiation by the parted lugs 9a is substantially higher than that from the lug 9a shown in FIGURE 3 in the unparted state. Conduction of heat to the lug or lugs 9a takes place equally satisfactorily, however, because each wall of the insert member forms an integral part with the associated lug portions.

In carrying out the invention, it is most advantageous if that part of the insert situated inside the anode and that situated outside the anode are made of one piece, because then optimum heat conduction is obtained. An effect considerably better than that obtained with the known anodes referred to above results, however, even if the parts of the insert member situated inside and outside the anode are composed of several pieces.

The anode shown in FIGURES 5 and 6 is an advantageous embodiment of the invention because, first, the insert member, which is shown in FIGURE 5, can be made from a single piece of sheet metal, and, secondly, the area of the insert member which projects through the slot in the anode is substantially larger than in the construction previously described.

The insert member 10 which may be formed from sheet-like metal, as shown in FIGURE 5, consists of a member of U-shaped cross section, about half the total length of which (about one quarter of the length at each end) is closed to form shoulders. The lower part of the U-shape defines a transverse portion. The member 10 is passed through slot 12 in anode member 1 as far as the shoulders formed from the projections of plates 10 allow. The longitudinal edges of the portion passed through the slot 12 are bounded by cross members 11. These cross members 11 merge into lugs 20 which are welded to corresponding lugs 19 of the anode member 1 after the insertion of the insert member 10 in the anode 1. FIGURE 6 illustrates such a finished anode member with insert.

In the embodiment illustrated in FIGURES 7 and 8, the insert member and radiation means form a single unit 13 which has three parts, two lateral members 14 and 15 and a central brace 16. These three parts are connected together by welding in a manner such that they form an H-section. The legs on one side of this section are passed through corresponding slots 17 and 18 in the anode member 1. This unit is secured to the anode member 1 by spot-welding the upper portions of the central brace 16 to the lugs 19 of the anode member. The finished anode member, with insert unit, is shown in FIGURE 8.

The insert unit shown in FIGURE 7 may also be made from two parts if two sheets of metal are placed close together in the plane of the part 16, joined together in the middle, and afterwards the lateral portions 14 and 15 are bent at appropriate angles.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. For use in an electric discharge tube having grid means defining a grid plane, a chamber anode comprising, in combination:

means forming an anode member having an active surface disposed substantially parallel to and facing said grid plane;

insert means arranged in said anode member, extending from the active surface thereof and facing toward said grid plane for dividing the interior of said chamber anode into a plurality of chambers; and

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radiation means, being an entity separate from said anode member, and in heat conducting relationship with said insert means and disposed exteriorly of said chamber anode, whereby heat is radiated from the insert means.

2. For use in an electric discharge tube having grid means defining a grid plane, a chamber anode comprising, in combination:

means forming an anode member having an active surface disposed substantially parallel to and facing said grid plane, said anode member being provided with a slot;

insert means arranged in said anode member, extending from the active surface thereof and facing toward said grid plane for dividing the interior of said chamber anode into a plurality of chambers; and

radiation means in heat conducting relationship with said insert means and disposed exteriorly of said chamber anode, said radiation means comprising an integral lug-like extension of said insert means, said extension projecting through said slot, whereby heat is radiated from the insert means.

3. A chamber anode as defined in claim 2 wherein said lug-like extension consists of two sheet-like metal portions extending from said insert means, which portions are bent away from each other along their extensions away from said anode member projecting through said slot.

4. For use in an electric discharge tube having grid means defining a grid plane, a chamber anode comprising, in combination:

means forming an anode member having an active surface disposed substantially parallel to and facing said grid plane, said anode member being provided with a slot;

insert means arranged in said anode member, extending from the active surface thereof and facing toward said grid plane for dividing the interior of said chamber anode into a plurality of chambers, said insert means including a sheet-like metal element of U-shaped cross section, the lower part of said U-shape defining a transverse portion; and

radiation means in heat conducting relationship with said insert means and disposed exteriorly of said chamber anode, said insert means having a portion which extends through said slot and forms said radiation means and which portion is a double thickness of said sheet-like metal element and is disposed symmetrically in relation to said U-shape, whereby heat is radiated from the insert means.

5. For use in an electric discharge tube having grid means defining a grid plane, a chamber anode comprising, in combination:

means forming an anode member having an active surface disposed substantially parallel to and facing said grid plane, said anode member being provided with a slot;

insert means arranged in said anode member, extending from the active surface thereof and facing toward said grid plane for dividing the interior of said chamber anode into a plurality of chambers;

radiation means in heat conducting relationship with said insert means and disposed exteriorly of said chamber anode, said insert means being U-shaped in cross section and extending through said slot to form said radiation means, said insert means extending longitudinally further than said slot in both directions to form shoulders which rest against said anode member whereby heat is radiated from the insert means.

6. A chamber anode as defined in claim 5, wherein said insert means and radiation means together consist of a single piece of sheet metal, multiply bent.

7. A chamber anode as defined in claim 6, wherein said single piece of sheet metal forms a pair of cross-members extending longitudinally from the ends of the transverse portion of said U-shaped radiation means, which cross-

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members conform to said shoulders, said cross members extending longitudinally further than said shoulders to form lugs flush with said anode member for securing the insert means thereto.

8. For use in an electric discharge tube having grid means defining a grid plane, a chamber anode comprising, in combination:

means forming an anode member having an active surface disposed substantially parallel to and facing said grid plane, said anode member having two, longitudinally extending, substantially parallel slots;

insert means arranged in said anode member, extending from the active surface thereof and facing toward said grid plane for dividing the interior of said chamber anode into a plurality of chambers; and

radiation means in heat conducting relationship with said insert means and disposed exteriorly of said chamber anode, said insert means and radiation means forming a single unit of H-shaped cross section, two legs of said H-shape extending through said longitudinally extending slots so that the transverse portion of said H-shape forms a central brace flush with said anode member, and said two legs radiate heat from the insert means.

9. For use in an electric discharge tube having grid means defining a grid plane, and a chamber anode including means forming an anode member having an active surface disposed substantially parallel to and facing said grid plane, there being a slot in said anode member;

insert means arranged in such anode member, extending from the active surface thereof and facing toward such grid plane for dividing the interior of the chamber anode into a plurality of chambers, said insert means being a sheet-like metal element of U-shaped cross section; and

radiation means in heat conducting relationship with said insert means, said radiation means being a double thickness of said sheet formed integrally with said insert means, disposed symmetrically in relation to

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said U-shape and extending through said slot exteriorly of said anode member.

10. For use in an electric discharge tube having grid means defining a grid plane, and a chamber anode including means forming an anode member having an active surface disposed substantially parallel to and facing said grid plane, there being a slot in said anode member;

insert means arranged in such anode member, extending from the active surface thereof and facing toward such grid plane for dividing the interior of the chamber anode into a plurality of chambers;

said insert means being U-shaped in cross section and extending through said slot to form radiation means, in the form of a chamber, for radiating heat from said insert means, said insert means extending longitudinally further than said slot in both directions to form shoulders which rest against such anode member, said insert means and radiation means together consisting of a single piece of sheet metal, multiply bent.

11. An insert means as defined in claim 10, wherein said single piece of sheet metal forms a pair of cross-members extending longitudinally from the ends of the transverse portion of said U-shaped radiation means, which cross-members conform to said shoulders, said cross-members extending longitudinally further than said shoulders to form lugs flush with said anode member for securing the insert means thereto.

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