

METHOD OF MANUFACTURING ELECTRON GUN FOR CATHODE RAY TUBE AND CATHODE ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates to a method of manufacturing an electron gun for a cathode ray tube and a cathode assembly in which a cathode, a first grid, and a spacer for a second grid are previously assembled in one piece.

One example of a related art electron gun for a cathode ray tube will be briefly described with reference to Fig. 2. The electron gun shown in this figure is of a Trinitron type to be incorporated in a color cathode ray tube, which is disclosed, for example in Japanese Patent Laid-open No. Hei 5-166459. The electron gun includes three cathode assemblies 100 in which a cathode, a first grid, and a spacer for a second grid are affixed in one piece. The electron gun also includes second to fifth grids G2 to G5. The three cathode assemblies 100 are mounted in an inclined posture to the second grid G2 through the spacer and the second grid G2 and the remaining third to fifth grids G3 to G5 are affixed to each other by means of bead glass 101 to assemble in the Trinitron type electron gun. The first grid G1 and the second grid G2

form a pre-focus system, and the third grid G3, the fourth grid G4, and the fifth grid G5 form a main lens system.

Fig. 3 shows one example of the cathode assembly 100, which is disclosed, for example in Japanese Patent Laid-open No. 7-14508. The cathode assembly includes a first grid G1; a supporting member 110 made from an insulating material to which the first grid G1 is affixed; and a cathode 111 disposed on the supporting member 110 opposite to the first grid G1. The first grid G1 is made from, for example a covar material, and the supporting member 110 is made from alumina based ceramics. A spacer 112 is mounted on the supporting member 110 on the side where the first grid G1 is mounted. A second grid G2 is mounted on an upper surface 112a of the spacer 112 (see Fig. 2). The spacer 112 defines a distance d12 between the first grid G1 and the second grid G2. The cathode 111 is composed of a cylindrical sleeve 120, a cap 122 put on the leading end of the sleeve 120, and an oxide 124 functioning as an emission source and provided on the top of the cap 122. The cathode 111 having such a configuration is inserted in a sleeve supporting member 128 mounted on the lower surface of the supporting member 110. A heater 126 is disposed inside the sleeve 120.

A method of assembling the cathode assembly 100

will be briefly described with reference to Fig. 4. A brazing jig 140 having a first face 140b and a second face 140c is first prepared. Shafts 140a are disposed on the first face 140b of the brazing jig 140. The second face 140c is formed outside the first face 140b in a state being lower than the first face 140b. A step between the first face 140b and the second face 140c is set to be equal to the distance d12 between the first grid G1 and the second grid G2. The first grid G1 and the spacer 112 are mounted on one side of the supporting member 110 made from an insulating material, and a cathode (not shown) is disposed on the other side of the supporting member 110. More specifically, the first grid G1 is placed on the first face 140b of the brazing jig 140 in a state being inserted in the shafts 140a disposed on the brazing jig 140, and the spacer 112 made from a metal such as a Fe-Ni alloy or Fe-Co-Ni alloy is placed on the second face 140c of the jig 140. Then, the supporting member 110 is placed on the first grid G1 and the spacer 112 in such a manner that a flat face 110b of the supporting member 110 is brought in contact with the first grid G1 and the spacer 112. In addition, the flat face 110b is previously subjected to metallization. The first grid G1 has at its center an emission hole E, and the supporting member 110 has a

through-hole 110a corresponding to the emission hole E (see Fig. 3). The supporting member 110 is pressed on the jig 140 side using a pressing member 140d, and in such a state, the first grid G1 and the spacer 112 are affixed to the flat face 110b of the supporting member 110 by a brazing method. Thus, the opposed faces of the first grid G1 and the supporting member 110, and the opposed faces of the spacer 112 and the supporting member 110 are brazed to each other.

In the related art assembling method, the first grid G1, the spacer 112, and the cathode supporting member 128 are affixed to the supporting member 110 made from ceramics or the like by brazing to assemble the cathode assembly; and the cathode sleeve 120 is inserted in the cathode assembly and welded thereto after measurement of the distance between the first grid G1 and the cathode 111 using an air-micrometer or the like. This method has an advantage that the parts can be accurately mounted because the distance d1 between the first grid G1 and the second grid G2 is previously set by the jig upon brazing before the cathode sleeve 120 is affixed to the cathode assembly. However, this method is disadvantageous in terms of assembling cost because the brazing jig 140 must have a high dimensional accuracy and a high resistance against

thermal deformation and also the supporting member 110 made from ceramics or the like for affixing the parts must be manufactured at a high processing accuracy. To cope with such an inconvenience, an alternate method has been proposed, in which parts are affixed using glass for reducing the assembling cost. The alternate method, however, has a disadvantage that the assembling accuracy is lower than that obtained by brazing, to make difficult management in the subsequent process.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a method of manufacturing an electron gun for a cathode ray tube, which is adapted to reduce the manufacturing cost while keeping the assembling accuracy; and to provide a cathode assembly suitable for the electron gun.

To achieve the above object, according to a first aspect of the present invention, there is provided a method of manufacturing an electron gun having a cathode and a plurality of grids for a cathode ray tube, including the steps of: assembling a first supporting member, a second supporting member, and a third supporting member in one piece by using an insulating material; affixing the first supporting member to a first grid; registering the first

grid with the second supporting member; affixing the second supporting member to a spacer which defines a gap between the first grid and a second grid; registering the first grid with the third supporting member; and affixing the third supporting member to a cathode. Preferably, the assembling step includes: affixing the second supporting member formed of a metal ring, the third supporting member formed of a metal cylinder and disposed inside the second supporting member, and the first supporting member formed of a pair of metal bars and disposed between the second supporting member and the third supporting member, to each other by hermetic sealing.

To achieve the above object, according to a second aspect of the present invention, there is provided a cathode assembly for an electron gun having a cathode and a plurality of grids for a cathode ray tube, including: a cathode for emitting electrons; a spacer which defines a gap between a first grid and a second grid; a first supporting member affixed to the first grid; a second supporting member affixed to the spacer; and a third supporting member affixed to a cathode; wherein the first, second and third supporting members are assembled in one piece. Preferably, the second supporting member formed of a metal ring, the third supporting member formed of a metal

cylinder and disposed inside the second supporting member, and the first supporting member formed of a pair of metal bars and disposed between the second supporting member and the third supporting member, are affixed to each other by hermetic sealing.

According to the above method, a cathode assembly is obtained by affixing a supporting member for supporting a cathode, a supporting member for supporting a first grid, and a supporting member for supporting a spacer, to each other by hermetic sealing, to obtain a base structure; accurately registering a first grid and a spacer to the base structure using a jig and affixing them thereto by welding; and accurately adjusting a distance between a cathode and the first grid and affixing the cathode to the corresponding supporting member by welding. The cathode assembly is assembled in an electron gun for a cathode ray tube. Accordingly, this method is advantageous in accurately setting a distance between a cathode and a first grid and a distance between the first grid and a second grid.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be apparent from

the following detailed description of the preferred embodiment of the invention in conjunction with the accompanying drawings, in which:

Figs. 1A to 1D are diagrams showing processing steps in a method of manufacturing an electron gun for a cathode ray tube according to the present invention;

Fig. 2 is a typical block diagram showing one example of a related art electron gun for a cathode ray tube;

Fig. 3 is a typical sectional view showing one example of a related art cathode assembly to be assembled in an electron gun for a cathode ray tube; and

Fig. 4 is a typical view showing a method of manufacturing the cathode assembly shown in Fig. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, one embodiment of the present invention will be described with reference to the drawings.

Figs. 1A to 1D are diagrams showing processing steps in a method of manufacturing an electron gun for a cathode ray tube according to the present invention. As shown in Fig. 1A, first supporting members 1 for affixing a first grid, a second supporting member 2 for affixing spacers for defining a distance between the first grid and

a second grid, and a third supporting member 3 for affixing a cathode are registered with each other at a relatively low accuracy and integrated to each other using an insulating material 5 to form a base structure 5. More specifically, the second supporting member 2 formed of a metal ring, the third supporting member 3 formed of a metal cylinder and disposed inside the second supporting member 2, and the first supporting members 1 formed of a pair of metal bars and disposed between the second supporting member 2 and the third supporting member 3 are integrally affixed to each other by hermetic sealing. In this case, crystallized glass is used as the insulating material 5. It is to be noted that the present invention is not limited to the above structure, and other alternate structures using no hermetic sealing may be used. For example, a ceramic part may be used as the insulating material 5 in place of hermetic sealing and each supporting member may be affixed to the insulating material 5 by means of glass. As compared with the related art method in which components are accurately registered with each other and then affixed to each other by brazing, the present invention is so configured that only supporting members for supporting components are affixed to each other at a relatively low accuracy by hermetic sealing or the like to form a base

structure 4.

Next, as shown in Fig. 1B, a first grid 6 is mounted to a pair of the first supporting members 1 by welding or the like. The first grid 6 is formed in a cup-shape capable of containing the top of the third supporting member 3, and it has an emission hole 7 at its center.

As shown in Fig. 1C, a pair of spacers 8 are mounted on the second supporting member 2 of the base structure 4 in a state being accurately registered with the first grid 6 previously mounted on the first supporting members 1. At this time, a distance between an upper surface 9 of the first grid 6 and an upper surface 10 of each spacer 8 is accurately set using a jig before a pair of the spacers 8 are welded to the second supporting member 2. A second grid will be mounted to the upper surfaces of the spacers 8 in the subsequent step. The distance between the upper surface 9 of the first grid 6 and the upper surface 10 of each spacer 8 defines the distance d_{12} between the first grid and the second grid. The distance d_{12} must be accurately controlled. Thus, there is obtained a cathode assembly 11 in which the first grid and the spaces for the second grid are integrated to each other.

As shown in Fig. 1D, a cathode 12 is mounted to the third supporting member 3 of the base member 4 in a state

being accurately registered with the first grid 6. The cathode 12 includes a cylindrical sleeve 13, a cap 14 put on the leading end of the sleeve 13, and an oxide functioning as an emission source and provided on the top of the cap 14. The sleeve 13 is inserted in the third supporting member 3. The cylindrical sleeve 13 has a base end slightly larger in diameter than the leading end. The sleeve 13 is temporarily mounted in the third supporting member 3 by frictional contact between the outer peripheral surface of the sleeve 13 and the inner peripheral surface of the third supporting member 3. After that, a distance d01 between the oxide 15 and the first grid 6 is measured using an air micrometer or the like, and it is suitably set. In addition, the measurement for the distance d01 using the air micrometer is performed by press-feeding air to the oxide 15 through the emission hole 7 formed in the first grid 6, and detecting a back pressure from the oxide 15. The sleeve 13 is welded to the third supporting member 3 after the distance between the oxide 15 and the first grid 6 is accurately adjusted.

The cathode assembly 11 thus finally assembled is mounted to the second grid through the spacers 8. After that, as shown in Fig. 2, the second grid G2, third grid G3, fourth grid G4, fifth grid 5 and the like are affixed

to each other by beading to complete an electron gun for a cathode ray tube.

As described above, according to the present invention, a first supporting member for affixing a first grid, a second supporting member for affixing spacers for defining a gap between the first grid and a second grid, and a third supporting member for affixing a cathode are registered with each other at a relatively low accuracy and are integrated to each other by hermetic sealing, to form a base structure; and the first grid, the spacers, and the cathode are mounted to the corresponding supporting members of the base structure at high accuracies. Accordingly, it becomes possible to easily and accurately set the distance d_{12} between the first grid and the second grid by means of the spacers. The present invention is also advantageous in terms of manufacturing cost because supporting members made from metal having various shapes can be freely affixed to each other at a relatively low accuracy by hermetic sealing or the like. Additionally, for electron guns different in diameter of the emission hole of the first grid and set value d_{12} , they can be easily manufactured only by changing the first grid part and the spacer mounting jig.

While the preferred embodiment of the present invention has been described using specific terms, such

description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.



WHAT IS CLAIMED IS:

1. A method of manufacturing an electron gun having a cathode and a plurality of grids for a cathode ray tube, comprising the steps of:

assembling a first supporting member, a second supporting member, and a third supporting member in one piece by using an insulating material;

affixing the first supporting member to a first grid;

registering the first grid with the second supporting member;

affixing the second supporting member to a spacer which defines a gap between the first grid and a second grid;

registering the first grid with the third supporting member; and

affixing the third supporting member to a cathode.

2. A method according to claim 1, wherein the assembling step comprises:

affixing the second supporting member formed of a metal ring, the third supporting member formed of a metal cylinder and disposed inside the second supporting member, and the first supporting member formed of a pair of metal



bars and disposed between the second supporting member and the third supporting member, to each other by hermetic sealing.

3. A cathode assembly for an electron gun having a cathode and a plurality of grids for a cathode ray tube, comprising:

a cathode for emitting electrons;

a spacer which defines a gap between a first grid and a second grid;

a first supporting member affixed to the first grid;

a second supporting member affixed to the spacer; and

a third supporting member affixed to a cathode; wherein the first, second and third supporting members are assembled in one piece.

4. A cathode assembly according to claim 3, wherein the second supporting member formed of a metal ring, the third supporting member formed of a metal cylinder and disposed inside the second supporting member, and the first supporting member formed of a pair of metal bars and disposed between the second supporting member and the third supporting member, are affixed to each other by hermetic sealing.