

# PATENT SPECIFICATION

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## (54) IN-LINE TYPE ELECTRON GUN ASSEMBLY FOR USE IN MULTI-BEAM TYPE COLOUR PICTURE TUBES

(71) We, HITACHI LIMITED, a corporation organised and existing under the laws of Japan, of 5—1, 1-chome, Marunouchi, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an in-line type electron gun assembly utilized for an in-line multi-beam type colour picture tube and more particularly to an in-line type electron gun assembly including a plurality of grid structures in which corresponding grid electrodes of respective electron guns emitting electron beams are constructed as integral grid structures.

A known electron gun assembly has disadvantages as will be made clear hereinafter.

It is an object of this invention to provide an improved in-line type electron gun assembly having a simple construction but substantially avoiding adverse effects which arise with the known construction. It is also an object of this invention to provide an improved in-line type electron gun assembly requiring a reduced number of steps for assembly.

According to this invention, there is provided an in-line type electron gun assembly wherein the grid electrodes of respective electron guns having the same function and constituting a main lens are formed into an integral grid structure, the grid structure comprising two electrode members each including a plate portion formed with three openings whose centres are disposed on a straight line across the plate portion, the two members being bonded together with the plate portions in spaced parallel relationship and with corresponding openings axially aligned in pairs, characterised in that the respective pairs of openings are shielded from one another between the plate portions by means of three sleeving means which extend

substantially between the plate portions in axial alignment with the openings of the respective pairs, said sleeving means consisting of a plurality of sleeves formed integrally with the plate portions of the two electrode members, one electrode member having two sleeves which respectively extend from around its outer openings at least a major part of the distance between the plate portions to the corresponding outer openings in the second electrode member, said second electrode member having a sleeve extending from around its central opening at least a major part of the distance between the plate portions to the corresponding central opening in the first electrode member.

Further features of the invention will be understood from the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a diagrammatic longitudinal sectional view showing the basic construction of an in-line type colour picture tube;

Fig. 2 shows a side view, partly broken away, of a known in-line type electron gun assembly;

Fig. 3 is a side view, partly broken away, showing one embodiment of the in-line type electron gun assembly embodying the invention;

Figs. 4 and 5 are perspective views, partly broken away, showing the construction of the fourth grid structure utilized in the electron gun assembly shown in Fig. 3, and

Fig. 6 is a side view, partly broken away, of another embodiment of the in-line type electron gun assembly of this invention.

An in-line type colour picture tube of the type with which the present invention is concerned generally comprises a fluorescent surface 12 or screen generating different colours (usually red, green and blue), formed on the inner surface of the face plate 11 of a glass bulb 10, and a colour selection electrode 13 spaced a predetermined distance from the fluorescent sur-

face. Further in the neck portion 14 of the glass bulb is disposed an in-line type electron gun assembly 15 comprising three electron guns emitting a plurality (three) of electron beams toward the fluorescent surface 12. A deflection coil 16 and a convergence adjusting means 17 are mounted to surround the neck portion 14. The electron beams emitted from the respective electron guns of the electron gun assembly are focussed on one point of the colour selection electrode 13 by the action of the magnetic fields produced by the convergence adjusting means 17 and the deflecting coil 16 and then caused to impinge upon corresponding phosphor dots on the fluorescent surface.

A known electron gun assembly 15 of the in-line type has a construction as shown in Fig. 2 wherein the grid electrodes of respective electron guns having the same function are combined into an integral grid structure.

More particularly, as shown in Fig. 2, three cathode electrodes 22a, 22b and 22c are arranged in side by side relationship along a line and are supported by a flat plate shaped cathode holder 21. Each cathode electrode is heated by a cathod heater 23 contained therein to emit electrons. In front of the cathode electrodes are disposed a first grid structure 24 for controlling the electron beams emitted by respective cathode electrodes, a second grid structure that accelerates the electron beams transmitted through the first grid structure, and third and fourth grid structures 26 and 27 in the form of short cylinders which are made of stainless steel, for example, and constitute an electron lens. These structures are secured to a glass bead 28 and function to cause the electron beams to impinge upon corresponding phosphor dots. The third grid structure 26 comprises upper and lower sections. Respective grid electrodes of the third and fourth grid structures 26 and 27 are also termed main lens electrodes and respectively comprise three juxtaposed circular openings 26a, 26b, 26c and 27a, 27b and 27c. The circular openings 27a, 27b and 27c provided for the fourth grid assembly 27 are made with larger diameters than the circular openings 26a, 26b and 26c provided for the third grid assembly 26, for the purpose of focusing the electron beams transmitted through these openings on the fluorescent surface irrespective of the diameter and pitch of the circular openings, thus forming the main lens between the groups of the openings.

Auxiliary electrodes 29 and 30 in the form of cylinders are secured to respective openings for the purpose of preventing the side walls of the third and fourth grid structures 26 and 27 from affecting the

electric fields formed therein.

In more detail, the openings 26a, 26b, 26c and 27a, 27b, 27c are not disposed at equal distances from the side walls of the third and fourth grid structures but instead they are disposed at asymmetrical positions. Accordingly, when predetermined potentials are impressed upon these grid structures, non-uniform or non-concentric electric fields are formed near the openings, thus causing aberrations which degrades the focusing characteristic. Such difficulty can be obviated by providing sleeves extending through respective grid structures from respective circular openings. Of course it is not necessary to provide such sleeves if integral sleeves or cylinders are formed to extend from the peripheries of respective openings. However, it is difficult to form three juxtaposed circular openings and integral sleeves having a desired length near the openings for the flat plates which are used to form the third and fourth grid structures, due to elongation of the flat plates. More particularly, the result of experiment shows that when the length of the sleeves is made greater than 60% of the opening diameter it is possible to prevent the adverse effect of the side walls of respective grid structures 26 and 27 upon the electric fields near respective openings. To simultaneously form sleeves having the same length for respectively juxtaposed circular openings by a single drawing operation is extremely difficult, especially when the grid structures are made of stainless steel.

Fig. 3 shows a preferred embodiment of the in-line type electron gun assembly of this invention in which elements corresponding to those shown in Fig. 2 are designated by the same reference numerals. Although the following description is made with reference to only the fourth grid assembly 27 it should be understood that the same description is also applicable to the third grid electrode. The fourth grid structure 27 shown in Fig. 3 comprises a combination of two electrodes, that is the first and second electrodes 40 and 41 respectively formed from flat plate members. As shown in Fig. 4, the first electrode 40 is constructed such that three openings 43a, 43b and 43c having the same diameter are provided for an electrode member 42 along a straight line. The openings 43a and 43c on both sides of the central opening 43b are provided with relatively long sleeves 44a and 44c having the same diameter as those of the openings 43a and 43c, said long sleeves 44a and 44c having the same length, whereas the centre opening 43b is provided with a relatively short sleeve 44b having the same diameter as that of the opening 43b. As shown in Fig. 5, the member 45 of the second electrode 41

is formed as a cup-like configuration and the bottom thereof is provided with openings 46a, 46b and 46c at positions corresponding to those of the openings 43a, 43b and 43c. 5 Openings 46a and 46c are provided with relatively short sleeves 47a and 47c whereas the opening 46b has a relatively long sleeve 47b. In the following description openings provided with the sleeves are termed "sleeved openings."

10 As shown in Figs. 4 and 5, the sleeves of respective pairs of sleeved openings 44a and 47a 44b and 47b, 44c and 47c project toward each other in axial alignment and the sum of 15 the lengths of the opposing sleeves of each pair is equal to a predetermined length. Each of the sleeved openings is formed by drawing respective members 42 and 45.

20 The first and second electrodes 40 and 41 constructed as above described are bonded together at their flanges to form a small gap A between opposed sleeves, as shown in Fig. 3. Alternatively, the opposing sleeves may contact directly with each other. However, 25 the presence of the gap A renders easier the task of assembling and working. The electrodes bonded in this manner are used as a portion of the electron gun assembly.

30 As can be clearly noted from the foregoing description, in the in-line type electron gun assembly embodying the invention, each grid structure comprising the main lens is formed by unitary bonding together of a pair of electrodes, one 35 electrode being provided with long and short sleeved openings alternately arranged along a straight line and the other electrode being provided with short and long sleeved openings alternately such that the sum of 40 the lengths of each pair of opposed sleeves is equal to a predetermined length. This construction can decrease the number of component parts and the number of fabrication steps.

45 Fig. 6 shows another embodiment of this invention wherein the short sleeves 44b, 47a and 47c of the previous embodiment are omitted. Accordingly, each sleeve extending from the first and second electrodes 50 respectively has a predetermined length. The flanges of the first and second electrodes 40 and 41 of the fourth grid structure are not joined as shown in Fig. 3, but are separated. In this modification, the relative 55 position between the two electrodes is determined by the glass bead 28. Further, the short sleeves of the third grid structure 26 are also eliminated. However, the side walls of the first and second electrodes 60 comprising the third grid structure extend toward each other so that the flanges of both side walls are bonded together. The third grid structure 26 is supported by the flange of the second grid structure located 65 thereunder. The relative position of the first

and second electrodes of the third and fourth grid structures may be reversed. Further, the long sleeve of the second electrode of the third grid structure 26 is shown to extent through the opening of the first electrode, but the sleeve may be terminated a short distance from the opening of the first electrode like that of the fourth grid structure. With this construction the short sleeved openings comprise mere 70 openings, so that the stamping operation of the electrodes become simple. Of course, when eliminating the short sleeves, it is necessary to increase the length of the longer sleeves to the predetermined length. 75

80 Although the invention has been shown and described in terms of some specific embodiments, it should be understood that the invention is not limited to these specific embodiments and that various modifications and alterations will be obvious to one skilled in the art without departing from the scope of the invention as defined in the appended claims. For example, instead of constructing 85 the first and second electrodes of each electron gun as an integral structure they may be constructed as separate units. Further, it should be understood that the invention is not limited to uni-potential type 90 but can also be applied to bi-potential type 95 of electron gun.

#### WHAT WE CLAIM IS:—

1. An in-line electron gun assembly wherein the grid electrodes of respective electron guns having the same function and 100 constituting a main lens are formed into an integral grid structure, the grid structure comprising two electrode members each including a plate portion formed with three openings whose centres are disposed on a 105 straight line across the plate portion, the two members being bonded together with the plate portions in spaced parallel relationship and with corresponding openings axially aligned in pairs, characterised in that the 110 respective pairs of openings are shielded from one another between the plate portions by means of three sleeving means which extend substantially between the plate portions in axial alignment with the 115 openings of the respective pairs said sleeving means consisting of a plurality of sleeves formed integrally with the plate portions of the two electrode members, one electrode member having two sleeves which 120 respectively extend from around its outer openings at least a major part of the distance between the plate portions to the corresponding outer openings in the second electrode member, said second electrode 125 member having a sleeve extending from around its central opening at least a major part of the distance between the plate portions to the corresponding central



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is formed as a cup-like configuration and the bottom thereof is provided with openings 46a, 46b and 46c at positions corresponding to those of the openings 43a, 43b and 43c. Openings 46a and 46c are provided with relatively short sleeves 47a and 47c whereas the opening 46b has a relatively long sleeve 47b. In the following description openings provided with the sleeves are termed "sleeved openings."

As shown in Figs. 4 and 5, the sleeves of respective pairs of sleeved openings 44a and 47a 44b and 47b, 44c and 47c project toward each other in axial alignment and the sum of the lengths of the opposing sleeves of each pair is equal to a predetermined length. Each of the sleeved openings is formed by drawing respective members 42 and 45.

The first and second electrodes 40 and 41 constructed as above described are bonded together at their flanges to form a small gap A between opposed sleeves, as shown in Fig. 3. Alternatively, the opposing sleeves may contact directly with each other. However, the presence of the gap A renders easier the task of assembling and working. The electrodes bonded in this manner are used as a portion of the electron gun assembly.

As can be clearly noted from the foregoing description, in the in-line type electron gun assembly embodying the invention, each grid structure comprising the main lens is formed by unitary bonding together of a pair of electrodes, one electrode being provided with long and short sleeved openings alternately arranged along a straight line and the other electrode being provided with short and long sleeved openings alternately such that the sum of the lengths of each pair of opposed sleeves is equal to a predetermined length. This construction can decrease the number of component parts and the number of fabrication steps.

Fig. 6 shows another embodiment of this invention wherein the short sleeves 44b, 47a and 47c of the previous embodiment are omitted. Accordingly, each sleeve extending from the first and second electrodes respectively has a predetermined length. The flanges of the first and second electrodes 40 and 41 of the fourth grid structure are not joined as shown in Fig. 3, but are separated. In this modification, the relative position between the two electrodes is determined by the glass bead 28. Further, the short sleeves of the third grid structure 26 are also eliminated. However, the side walls of the first and second electrodes comprising the third grid structure extend toward each other so that the flanges of both side walls are bonded together. The third grid structure 26 is supported by the flange of the second grid structure located thereunder. The relative position of the first

and second electrodes of the third and fourth grid structures may be reversed. Further, the long sleeve of the second electrode of the third grid structure 26 is shown to extend through the opening of the first electrode, but the sleeve may be terminated a short distance from the opening of the first electrode like that of the fourth grid structure. With this construction the short sleeved openings comprise mere openings, so that the stamping operation of the electrodes become simple. Of course, when eliminating the short sleeves, it is necessary to increase the length of the longer sleeves to the predetermined length.

Although the invention has been shown and described in terms of some specific embodiments, it should be understood that the invention is not limited to these specific embodiments and that various modifications and alterations will be obvious to one skilled in the art without departing from the scope of the invention as defined in the appended claims. For example, instead of constructing the first and second electrodes of each electron gun as an integral structure they may be constructed as separate units. Further, it should be understood that the invention is not limited to uni-potential type but can also be applied to bi-potential type of electron gun.

#### WHAT WE CLAIM IS:—

1. An in-line electron gun assembly wherein the grid electrodes of respective electron guns having the same function and constituting a main lens are formed into an integral grid structure, the grid structure comprising two electrode members each including a plate portion formed with three openings whose centres are disposed on a straight line across the plate portion, the two members being bonded together with the plate portions in spaced parallel relationship and with corresponding openings axially aligned in pairs, characterised in that the respective pairs of openings are shielded from one another between the plate portions by means of three sleeving means which extend substantially between the plate portions in axial alignment with the openings of the respective pairs said sleeving means consisting of a plurality of sleeves formed integrally with the plate portions of the two electrode members, one electrode member having two sleeves which respectively extend from around its outer openings at least a major part of the distance between the plate portions to the corresponding outer openings in the second electrode member, said second electrode member having a sleeve extending from around its central opening at least a major part of the distance between the plate portions to the corresponding central



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opening in the first electrode member.

2. The electron gun assembly according to Claim 1, wherein the central opening of the first electrode member is provided with a relatively short sleeve, the openings on both sides of said central opening are provided with relatively long sleeves, the central opening of the second electrode member is provided with a relatively long sleeve, and the openings on both sides of the last mentioned central opening are provided with relatively short sleeves, the sum of the lengths of the short and long sleeves for each pair of openings being equal to a predetermined length not substantially less than the distance between the plate portions of the two electrode members.

3. The electron gun assembly according to Claim 1 or Claim 2, wherein said first electrode member comprises a plate member constituting the plate portion of said first electrode member and said second electrode member is formed in a cup-like configuration with its sleeve or sleeves standing therein on its base, said base constituting the plate portion of said second electrode member.

4. The electron gun assembly according to Claim 3, wherein the side wall of the cup-like second electrode member is formed with a flange around its free end edge and the first electrode member is bonded to said second electrode member at said flange.

5. The electron gun assembly according to Claim 2 or Claim 3 or Claim 4, as appended to Claim 2, wherein the opposing ends of

said long and short sleeves for each pair of openings are spaced by a predetermined small gap.

6. The electron gun assembly according to any one of Claims 1 to 5, wherein all the openings in the electrode members and all the sleeves associated therewith have the same inner diameter.

7. The electron gun assembly according to Claim 1, wherein said plurality of sleeves consists of the said two sleeves on the first electrode member and the said sleeve on the second electrode member, each sleeve having a predetermined length not substantially less than the distance between the plate portions of the two electrode members.

8. The electron gun assembly according to any one of Claims 1 to 7, wherein a plurality of the grid structures juxtaposed along the axis of the electron gun assembly to form a main lens are disposed such that the openings of the second electrode members of respective grid structures oppose each other.

9. An electron gun assembly substantially as hereinbefore described with reference to any of Figs. 3 to 5 or Fig. 6 of the accompanying drawings.

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