

The invention relates to an electron gun for a cathode ray tube, in particular for colour television.

A cathode ray tube is constituted by an evacuated glass envelope having at its front portion a screen whose internal face is covered with cathodoluminescent materials (termed luminophores) emitting visible light rays when excited by an electron beam produced by one (or more) electron gun. For a colour display, the screen is in general formed from triplets of luminophores, one for each primary colour, usually red, green and blue. Three electron guns are provided in a mask type colour display tube, each being intended to excite a particular colour, the perforated mask disposed in front of the screen making it possible for the electron beam provided for one colour to excite only the luminophores of this colour.

An electron gun is formed, on the one hand, by a cathode with a surface which emits electrons when it is heated by a filament and, on the other hand, by electrodes or grids generally denoted G_1 , G_2 , G_3 , etc., - where the index represents the position with respect to the cathode, this index increasing with distance from the cathode - the first two of which, G_1 and G_2 , bring about a prefocusing of the electron beam and the following ones, G_3 , G_4 , etc., form electrostatic lenses for focusing and concentrating the electron beam. The modulation of the electron beam as a function of the intensity of the point to be projected on the screen is obtained by modulation of the potential of the cathode or by modulation of the potential of the first grid G_1 (Wehnelt).

The electrodes of the electrostatic lenses are usually brought to very high potentials, most often of the order of several kilovolts. The invention relates more particularly to a tube of which at last one grid of the electrostatic lenses is, in normal operation, brought to a very high potential, for example of the order of 25 kilovolts, and which retains a potential of the same order of magnitude for a considerable time after the supply to this tube is cut off. This potential does not

disappear immediately for the following reason: the glass envelope possesses an internal conductive coating to which the said grid is connected, as well as an external conductive coating brought to ground potential; the glass envelope thus constitutes, with its coatings, a high capacity capacitor which retains its charge for a long period even after it has been disconnected from its supply source; due to this the internal coating and the electrode connected to it retain the high potential.

It has been observed that the high potential retained on a grid could cause - when the distance separating this grid from the cathode is relatively small - the projection of electrons to the centre of the screen, revealing itself by one or more luminous spots which are visible as long as the temperature of the cathode remains high. Such a fault is sometimes termed "cathode glow".

To remedy this disadvantage, it has been proposed to dispose discharge diodes in the circuit outside the tube; but this solution is costly.

The invention, according to Claim 1, enables the phenomenon of cathode glow, appearing when the tube supply is cut off, to be suppressed at low cost.

It is characterized in that, to remove from the cathode the effect of the high potential remaining on a grid after the tube supply has been cut off, masking means are interposed between this grid and the cathode, the said masking means forming part of an intermediate grid which, after the supply is cut off, is brought to ground potential, the said intermediate grid, which is of elongate form with transverse end walls, is such that the end wall nearest to the cathode is thicker than the opposite wall. As a variant, according to Claim 7 the aperture of this end wall nearest to the cathode has a rim or small collar, advantageously turned towards the interior of this elongate grid.

Another embodiment of the intermediate grid is constituted according to Claim 10. It has been observed that good results were obtained when the ratio of these

diameters is at most 0.92.

Other characteristics and advantages of the invention will appear when certain of its embodiments are described with reference to the attached drawings, in which:

- Figure 1 is a sectional diagram of an electron gun for a colour television tube, with three in-line beams, incorporating the improvement of the invention,

- Figures 2a and 2b are even more diagrammatic drawings of electron guns of the same type as those of Figure 1, on the one hand without, and on the other hand with, the improvement of the invention and showing the effect of this improvement,

- Figure 3 shows an element of the gun of Figure 1,

- Figure 4 is a section along the line 4-4 of Figure 3,

- Figure 5 shows a grid of the gun of Figure 1 for a variant,

- Figure 6 shows a part of a grid of the gun of Figure 1 for another variant, and

- Figure 7 is a view similar to that of Figure 2b, but for a variant.

The example which will be described in relation to the Figures relates to an electron gun for a mask type colour television tube, the three beams produced by the (triple) gun being said to be in-line, that is, coplanar.

Such an electron gun comprises, on the one hand, three cathodes K each having an emissive surface 10 perpendicular to the axis 11 of the tube and heated by a filament (not shown) and, on the other hand, an assembly of electrodes G_1 , G_2 , G_3 , G_4 , G_5 , and G_6 , of which the first two, G_1 and G_2 , effect prefocusing and the following ones, G_3 to G_6 , constitute electrostatic lenses for focusing and concentrating the electron beams.

One cathode K is on the axis 11 of the tube, while the axes of the two others are parallel to the axis 11, in the same plane, and in symmetrical positions with respect to this axis 11.

The electrodes G_1 , G_2 and G_4 , of generally planar form, each comprise three circular apertures centered on the axis of the corresponding cathode to permit passage of the electron beam arising from this cathode, while the elongate electrodes G_3 , G_5 , and G_6 , substantially cylindrical or parallelepipedal in shape, have end walls each of which likewise has three circular apertures centered on the axis of the corresponding cathode. Figure 1, being a section along the axis of the tube, shows only the central cathode and the corresponding apertures of the electrodes.

The electrodes or grids G_3 and G_5 are connected to a terminal 3 receiving a potential of medium value, of the order of 8 kilovolts, while the electrodes or grids G_4 and G_6 are connected to a terminal 4 connected to a source of high potential, of the order of 25 kilovolts. In a manner known per se, the assembly formed by the electrodes or grids G_3 , G_4 and G_5 constitutes an electrostatic lens of unipotential type, termed "Einzel", while the electrodes or grids G_5 and G_6 constitute an electrostatic lens termed bipotential.

Each of the electrodes is metallic and is formed from a sheet of constant thickness. Thus the elongate portion 12 of the electrode G_5 has the same thickness as the end walls 13 and 14. In the example, to facilitate the manufacture of the electron gun, the apertures of the electrode G_4 and of the end walls of the electrodes G_5 and G_6 , as well as the apertures of the end wall 15 of the grid G_3 which is furthest from the cathode K, all have the same diameter. In contrast, the apertures of the grids G_1 and G_2 , as well as the apertures of the wall 16 of the grid G_3 which is turned towards the cathode K, have smaller diameters.

The grid G_3 , like the grid G_5 , has a substantially cylindrical or parallelepipedal general shape, the cylindrical wall 17 and the end walls 15 and 16 having the same thickness. But to the wall 16, of the same thickness as the wall 15, there is welded, according to an embodiment of the invention, a plate or insert 18

(Figures 3 and 4) with apertures 19, 20 and 21 corresponding to the apertures of the wall 16, that is, of the same diameter and of the same relative disposition. The plate 18 is welded against the internal face of the wall 16, for example at four weld points in the neighbourhood of its corners.

This welding is effected before the electrodes are mounted, that is, before the two cups 22 and 23 constituting the two parts of the electrode G_3 are assembled together.

In the example, the assembly constituted by the walls 16 and 18 has a thickness which is about three times greater than the thickness of the wall 15; in other words, the insert 18 has a thickness which is about twice that of the walls of the original grid G_3 .

As explained above, when the tube supply is cut off the terminal 4 retains a potential of the order of 25 kilovolts, while the potentials of the other electrodes almost immediately reach zero (ground potential).

Since the distance L separating the cathode K from the electrode G_4 is relatively small, of the order of 1 cm in the example, the influence of the potential of this electrode G_4 can make itself felt in the neighbourhood of the cathode K and cause the undesired formation of an electron beam along the axis of the gun, which will give rise to a parasitic glow in the centre of the screen. Thus, without the improvement of the invention, as shown in Figure 2a, the equipotential surface 25 (of 3.5 to 5 volts), constituting the limit of the zone of influence of the potential induced by the electrode G_4 , is in the neighbourhood of the grid G_2 ; a proportion of electrons which is not negligible thus reaches the central region of the screen. In contrast, with the improvement of the invention, as shown in Figure 2b, the limit 25' of influence of the potential induced by the grid G_4 is markedly further from the cathode K , so that the proportion of electrons which will reach the central portion of the screen is considerably reduced and thus there will be hardly any parasitic glow visible at the

centre of this screen.

Experiments have shown that, without the improvement of the invention, the parasitic glow is visible, with a wall 16 of thickness 0.25 mm and a nominal filament supply voltage of 6.3 volts for the cathode K, when the voltage on the grid G_4 reaches 12 kilovolts. In contrast, with the improvement of the invention, the thickness of the front wall, turned towards the cathode, of the grid G_3 being 0.75 mm, the parasitic glow only appears if the cathode filament supply voltage is 9 volts and if the electrode G_4 is brought to a potential of at least 32 kilovolts.

In this example, the thickness of the front wall of the grid G_3 is of the order of three times the thickness of its back wall 15. Satisfactory elimination of the cathode glows is still obtained when this thickness of the front wall is about double the thickness of the back wall.

In the variant shown in Figure 5, the electrode G_3 is in two portions, the first comprising only the front wall 30, of thickness greater than the remainder, 31, of the electrode G_3 . This second portion 31 comprises the elongate portion and the other end wall.

The portions 30 and 31 are assembled by welding, for example.

Figure 6 shows yet another embodiment in which the front wall 16' of the electrode G_3 has the same thickness as the other portions of this electrode, but the apertures of this front wall 16' are all bordered by a small collar or rim 32. The advantage of this embodiment is that it only requires a slight modification of the known electron gun.

In a variant of the embodiment shown in Figure 1, the holes 19, 20 and 21 of the insert 18 have a diameter greater than the diameter of the corresponding holes of the wall 16. But in this case it is preferable for the thickness of the insert to be greater than that which it has when the diameters are equal. In other words, it is preferable for the thickness of the insert to increase

with the diameter of its aperture.

In the embodiment shown in Figure 7, the aperture of the wall 15 of the grid G_3 has a diameter d_3 which is less than the diameter d_4 common to the aperture of the grid G_4 and to the front aperture, turned towards the cathode, of the grid G_5 . In other words, the ratio d_3/d_4 is less than 1.

The equipotential line L_2 , corresponding to the line 25 of Figure 2a (or 25' of Figure 2b), intersects the axis z at a point B practically within the grid G_3 . It is observed that, here also, the influence of the high voltage of the grid G_4 is thus reduced by the reduction of the diameter d_3 (if a comparison is made with Figure 2a). It has been observed that a ratio d_3/d_4 of 0.6875 enabled a good compromise to be obtained between the quality of the cathode image in the formation of an image and the reduction of the parasitic phenomenon of cathode glow on cutting off the supplies.

However, the hole of the wall 15₁ of the grid G_3 has, as in Figure 1, a small cylindrical collar which extends within the cylinder G_3 . This small collar can be obtained on manufacture of G_3 by extrusion. Its effect enables the reduction of the ratio d_3/d_4 , necessary for the invention, to be diminished. In an embodiment for a compromise comparable to that obtained before, a ratio d_3/d_4 of 0.844 has been produced.

The invention obtains the desired result by limiting the influence of the high value equipotential lines in the beam formation zone. In other technologies than that described above, such an effect can be produced, in particular, by increasing the dimensions of the holes of the grids following the grid which has a very high voltage.

The invention is also applicable to the case where the grid G_4 is thick, for example produced in the form of a cylinder. Its proximity to the filament being unchanged, the problem, and the solution of the invention, remain.



CLAIMS

1. Electron gun for a cathode ray tube, in particular for colour television, the electrostatic lenses of which comprise an electrode (G_4) which remains at a high potential after the tube supply is cut off, characterized in that, to reduce the effect on the cathode (K) of the high potential remaining on the said electrode (G_4) after the supply is cut off, the gun comprises means to confer on the interval between the cathode and an equipotential surface constituting the limit of the zone of influence of the potential induced by the said electrode which remains at the high potential, a value such that this high potential remaining on the said electrode (G_4) after the supply is cut off has a small effect on the cathode, these means comprising masking means forming a part of an electrode of the electron gun having a position intermediate between the electrode (G_4) with a high potential and the cathode, and in that the intermediate electrode (G_3), brought to ground potential, has a form which is elongate along the axis (11) of the gun, with two end walls (15, 16, 18), the end wall turned towards the cathode having, to effect the said masking, a thickness greater than that of the opposite wall (15).

2. Electron gun according to Claim 1, characterized in that the ratio between the thicknesses of the end walls of the intermediate electrode (G_3) is at least of the order of 2.

3. Electron gun according to Claim 1 or 2, characterized in that the intermediate electrode (G_3) comprises a principal portion with end walls (15, 16) of equal thicknesses and an insert (18) added to the end wall (16) turned towards the cathode.

4. Electron gun according to Claim 3, characterized in that the insert (18) is welded onto the end wall.

5. Electron gun according to Claim 3 or 4, characterized in that the insert (18) is added to the face of the end wall of the intermediate electrode (G_3)



which is within this electrode.

6. Electron gun according to Claim 1, characterized in that the intermediate electrode (G_3) comprises two portions, one of which is constituted by the thicker end wall (30) and the other (31) is constituted by the longitudinal portion and the other end wall.

7. Electron gun for a cathode ray tube, in particular for colour television, the electrostatic lenses of which comprise an electrode (G_4) which remains at a high potential after the tube supply is cut off, characterized in that, to reduce the effect on the cathode (K) of the high potential remaining on the said electrode (G_4) after the supply is cut off, the gun comprises means to confer, on the interval between the cathode and an equipotential surface constituting the limit of the zone of influence of the potential induced by the said electrode which remains at the high potential, a value such that this high potential remaining on the said electrode (G_4) after the supply is cut off has a small effect on the cathode, these means comprising masking means forming a part of an electrode of the electron gun having a position intermediate between the electrode (G_4) with a high potential and the cathode, and in that the intermediate electrode (G_3), brought to ground potential, has an elongate form with two end walls (15, 16'), the aperture of the end wall turned towards the cathode having a rim (32) which effects the said masking.

8. Electron gun according to Claim 7, characterized in that the rim (32) is turned towards the interior of the intermediate electrode (G_3).

9. Electron gun according to any one of the preceding claims, characterized in that the diameter of the circular aperture of the electrode (G_4) brought to a high potential is equal to the diameter of the corresponding aperture of the rear end wall (15), opposite to the cathode, of the intermediate electrode (G_3).

10. Electron gun for a cathode ray tube, in particular for colour television, the electrostatic lenses of which comprise an electrode (G_4) which remains at a



high potential after the tube supply is cut off, when it is incorporated into the tube and connected to the internal conductive coating, characterized in that, the said electrode (G_4) having the highest potential in normal operation, to reduce the effect on the cathode (K) of the high potential remaining on this electrode (G_4) after the supply is cut off, the gun comprises means to confer, on the interval between the cathode and an equipotential surface constituting the limit of the zone of influence of the potential induced by the said electrode which remains at the high potential, a value such that this high potential remaining on the said electrode (G_4) after the supply is cut off has a small effect on the cathode, these means comprising masking means forming a part of an electrode of the electron gun having a position intermediate between the electrode (G_4) with a high potential and the cathode, and in that the intermediate electrode (G_3), brought to ground potential, has a form which is elongate along the axis of the gun, with two end walls, the wall which effects the said masking, turned towards the electrode (G_4) with a high potential, having a hole of diameter (d_3) such that the ratio of this diameter (d_3) to that (d_4) of the neighbouring hole of the grid with a high potential is substantially smaller than 1.

11. Electron gun according to Claim 10, characterized in that the ratio of the diameter (d_3) of the hole of the first grid to that (d_4) of the neighbouring hole of the second grid is at most 0.92.

12. Gun according to Claim 11, characterized in that the said ratio is of the order of 0.69.

13. Electron gun according to Claim 11, characterized in that the said ratio is of the order of 0.85.

14. Gun according to Claim 10, characterized in that the aperture of the wall of the intermediate grid which is turned towards the electrode or grid with a high potential is bordered by a small collar towards the interior of this intermediate grid (G_3).

15. Electron gun according to any one of the preceding claims, characterized in that, in a manner



known per se, it comprises a bipotential lens (G_5 , G_6) and an Einzel lens (G_3 , G_4 , G_5), the electrode (G_4) brought to a high potential and the intermediate electrode (G_3) both forming parts of the Einzel lens.

16. Cathode ray tube, characterized in that it has an electron gun according to any one of the preceding claims.

17. Colour television receiver, characterized in that it has a tube according to Claim 17 (sic).