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ELECTRON GUN STRUCTURE

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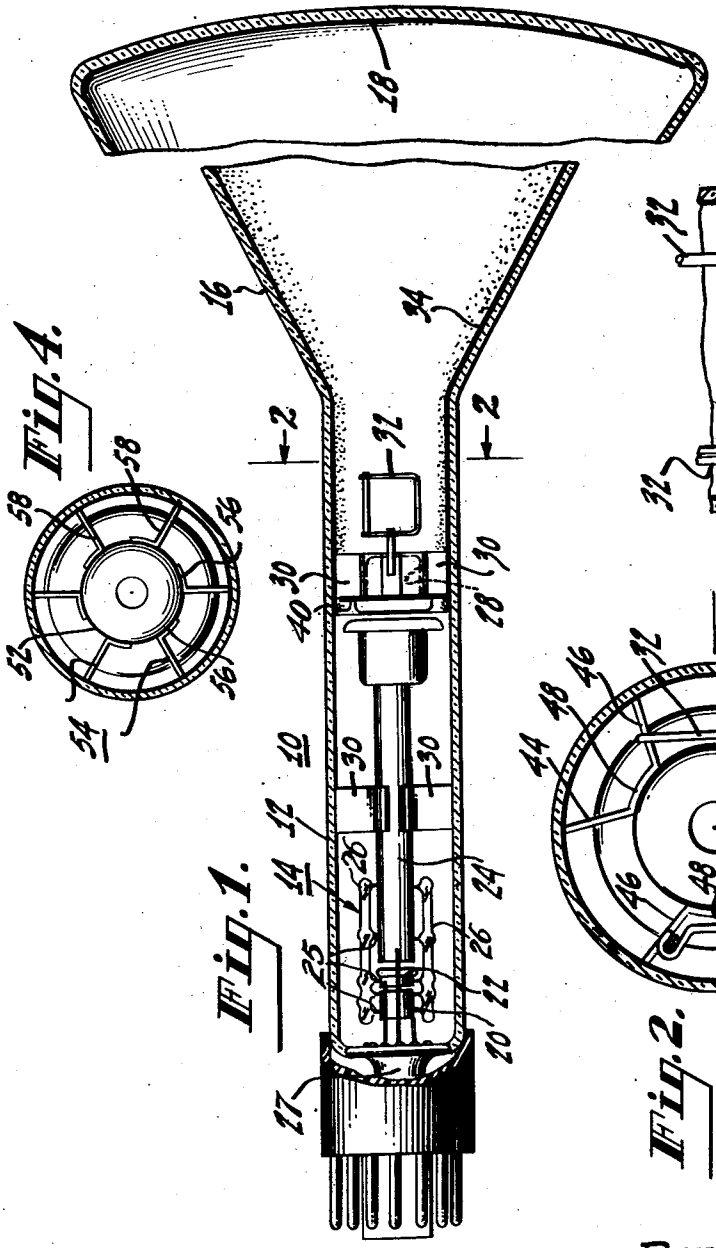


Fig. 1.

Fig. 4.

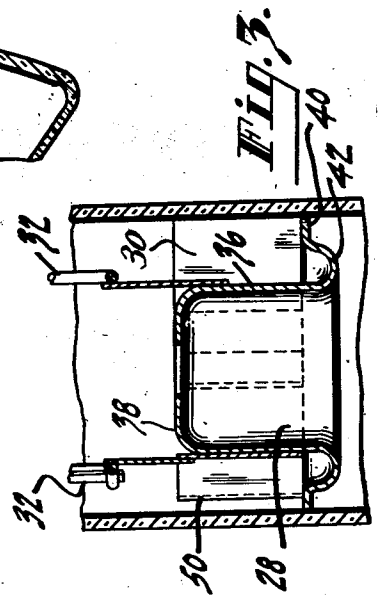


Fig. 3.

Fig. 2.

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ELECTRON GUN STRUCTURE

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9 Claims. (Cl. 313—82)

This invention relates to electron guns for use in electron beam tubes and particularly to an improved second anode structure for high voltage projection type cathode ray tubes.

As advances have been made in the projection tube art, many problems have arisen due to the fact that extremely high voltages are used in the operation of such tubes. One problem concerns the isolation of external components such as deflection yoke and the like from the high voltage components within the tube. In one phase of development, a double-walled envelope was employed to provide such high voltage isolation.

For example, the use of a double-walled envelope to reduce the possibility of an insulation breakdown from the second anode layer on the inside wall of the tube to some external element such as the deflection yoke or magnetic focusing coil is disclosed in U. S. Patent 2,289,906. In this patent it is pointed out that, in addition to increasing the spacing between the second anode layer and the outside surface of the tube, this construction also assures long glass-surface leakage paths between the second anode and the lower-voltage elements of the tube. In order to obtain an appropriate inner wall for supporting the second anode layer there is fused to the inside of the bulb of the envelope an inner glass structure which is re-entrant into the bulb in the direction toward the electron gun and comprises a frusto-conical portion with its large end fused to the bulb and its small end terminating in a short inner neck which extends for a short distance within the outer neck towards the gun. Since there was usually a ragged edge on the second anode conductive coating where it terminated at the end of the inner neck and since this tended to cause electrical discharges and distortions of the electric field, i. e., of the electrostatic lens, between the first and second anodes, a smooth metal ring-cap was placed over the end of the inner tube neck.

However, certain disadvantages have been encountered in seeking to practice the invention taught in this patent. One of these has been that during radio frequency heating, such as for de-gassing and/or exhausting the tube, expansion of the close-fitting metal ring-cap often cracked the end of the inner neck. This required that the ring-cap be very light to avoid its being excessively rigid and strong with respect to the glass.

Another disadvantage has been that the ring-cap was often out of alignment with the other elements of the electrostatic lens system since its position depended upon the accuracy with which the inner glass structure was attached to the outer tube envelope. In practice it is ordinarily attached by fusing the large end of the frusto-cone to the inside of the bulb so that most of its structure extends without other support for a considerable distance toward the gun. Therefore the slightest inaccuracy in fusing together the inner and outer portions of the envelope results in a noticeable misalignment between the inner and outer necks.

Still another disadvantage has been that where the ring-cap was mounted in direct contact with the glass, considerable heat transfer occurred during radio frequency heating and this often damaged the conductive coating comprising the second anode.

Finally, since the ring-cap has usually been made as an inner neck rim which is as narrow and light-weight as possible to reduce the amount of breakage caused during radio frequency heating, it has not been effective to reduce the opening into the inner neck. This leaves a large entrance into the final anode which permits cold-emission electrons to enter and heavy positive ions to leave. If unfocused cold-emission electrons reach the fluorescent screen they will reduce the picture contrast. On the other hand if heavy positive ions existing within the final anode are free to "see" the lower potentials existing further back in the tube and to move out of the second anode towards them, they will probably harmfully bombard the cathode. One solution to this problem is described in a co-pending R. H. Hughes application, Serial Number 293,175, filed June 12, 1952, now Patent No. 2,734,141 and assigned to the assignee of this application. The solution provided in that application comprises forming the shield member with diaphragms or the like to prevent the passage of undesired cold emission electrons or ions. In addition, flexible members are connected at one end to the shield electrode and at their other ends to the inner glass structure of the kinescope and provide a certain amount of positioning and support for the shield electrode. However, high precision centering and permanent proper positioning of the shield electrode with respect to the other electrodes of the electron gun is not obtainable. In addition, since the flexible members are fused in the wall of the inner neck to provide electrical contact with the internal conductive coating, such a construction might prove undesirable in a tube having a single neck with the shield electrode positioned in the single neck. Thus the prior art does not provide any teaching whereby a second anode could be independently supported and precisely centered in a single-neck envelope in contact with an internal conductive coating on the neck.

Accordingly, the principal object of this invention is to provide an improved electron gun in a high voltage cathode ray tube.

Another object is to provide an improved second anode assembly in a high voltage cathode ray tube.

A further object is to provide an improved shield electrode between the first anode of an electron gun and the internal conductive coating in a projection type cathode ray tube.

Another object is to provide an improved shield electrode in an electron gun, said electrode having a combined centering and supporting means adapted, in addition, to provide an electrical contact.

A further object is to provide a simple and effective supporting and centering means for the component parts of an electron gun.

Another object is to provide improved electrode centering and alignment means adapted to provide electrical contact with portions of an electron beam device.

In general, the improved electron gun structure according to the present invention includes a focusing and shielding electrode or second anode positioned between the first anode and the internal conductive coating and in contact with the coating. The shielding electrode has an aperture for passing an electron beam and means for preventing the passage of cold emission electrons or positive ions in either direction along the tube. The shield electrode is accurately centered and aligned with other electrodes in the neck of the tube envelope by means

of a plurality of flexible, metallic, V-shaped members providing electrical contact with the inner conductive coating on the envelope wall. Other components of the electron gun may be similarly supported.

In one embodiment of the invention, a plurality of fin-like sheet metal members are utilized to center and align the components of an electron gun.

The invention is described with reference to the drawing wherein:

Fig. 1 shows, in elevation and partly in section, one type of cathode ray tube embodying the improved electron gun of the invention;

Fig. 2 is an enlarged sectional view of the electron gun shown in Fig. 1 along the line 2—2;

Fig. 3 is a sectional view of the same electron gun along the line 3—3 of Fig. 2; and

Fig. 4 is a sectional plan view of a modification of the invention.

Fig. 1 shows an electron beam device or kinescope **10** in which is embodied the improved gun structure disclosed herein. The device **10** is a high voltage projection kinescope suitable for theater television receiving systems. However, the principles of the invention are applicable to other electron beam devices. Tube **10** includes an envelope having a neck portion **12** for housing an electron gun **14** and a bulb portion **16** having a phosphor screen **18** at one end thereof.

The electron gun **14** includes a grid-cathode assembly **20**, which produces an electron beam, and adjacent to the grid-cathode assembly **20** there is a second grid electrode **22**. Adjacent to the end of the second grid electrode **22** which faces away from the grid-cathode assembly **20** is a first accelerating anode **24**. The grid-cathode assembly **20**, second grid **22** and first anode **24** are interconnected and formed into a unitary assembly by means of a number of circumeferentially disposed supporting members **25** each of which has its inner end welded to one of the electrodes and its outer end fused into one of a number of circumferentially disposed elongated insulating glass beads **26** which extend inside and lengthwise of the neck **12**. The usual supports are provided for supporting portions of the electron gun **14** in a press **27**.

According to the invention, the electron gun **14** is capped with a shielding and focusing electrode or second anode **28** and further, according to the invention, the shield electrode **28** and the first anode **24** are supported, centered, and aligned within the neck **12** by a plurality of spacers **30** which are welded to the outer surface of each of the electrodes. A plurality of getters **32** are connected to the shield electrode **28**. The final anode of the electron gun consists of a layer **34** of conductive material such as aquadag which is deposited on a portion of the inner surface of the neck **14** and extends into the bulb portion **16** of the envelope up to the phosphor screen **18**. The shield electrode **28** is positioned so that the support devices **30** welded thereto are in contact with the internal conductive coating or final anode **34**.

According to the invention and referring to Figs. 2 and 3, the improved shielding and focusing electrode **28** may be formed from a single piece of metal, for example stainless steel, and comprises a hollow generally tubular body **36** having an apertured closure **38** at one end facing the phosphor screen **18** and having an annular outwardly extending lip or disk **40** at its other end. The lip **40** is connected to the main body **36** of the electrode **28** by an annular trough or connecting portion **42** of U-shaped cross section the base of which is smoothly rounded to prevent arcing in a high voltage field. The point of connection of the lip **40** with the U **42** is at the end of the outer arm of the U whereby the disk is positioned remote from the base of the U and extends outwardly from the main body **36** of the electrode at a point intermediate the ends thereof. The portion **42** may also be considered an outwardly-rounded annular portion at the end of the body **36**, having the annular

lip or disk **40** extending outwardly therefrom at a region spaced from the end thereof. The disk **40** is also disposed farther away from the first anode **24** than the rounded surfaces of the annular trough **42**, as shown in Fig. 1. This increases the electrical leakage path along the inside wall of the neck **12** between the outer periphery of the disk **40** and the outer periphery of the first anode **24**, and thus reduces any tendency for arcing to occur between those two points.

According to the invention, the positioning and centering means **30** for the shield electrode **28** and the electrode **24** comprise a number of generally V-shaped, moderately flexible, metallic vane-like members of sheet metal. They are welded or otherwise connected to the main body portions of the electrodes.

The V-shaped members **30** have thin, resilient, fin-like arms **44**, **46** interconnected by a portion **48** which constitutes the base of the V. The arms **44**, **46**, which may be rectangular as shown in the drawing, have a comparatively large width dimension parallel to the axis of the neck **12** and a comparatively small length. The length of each arm **44**, **46** is greater than the radial spacing between the corresponding electrode and the inside surface of the neck **12** so that when the electrode is in supported position, the ends of the arms **44**, **46** are in spring pressing engagement with the inside surface of the neck **12**. Thus narrow lines of contact **50** are provided on the inner wall of the neck by each arm of each spacer **30**. The outer edges of the arms **44**, **46** are parallel to the longitudinal axis, or axis of symmetry, of the corresponding electrode. Corresponding arms **44**, **46** of each of the spacers **30** connected to each electrode extend from the connecting portions **48** at substantially the same angle so as to insure proper centering and alignment with the axis of the neck **12** of the electrodes **24** and **28** within the neck **12**. Any number of positioners or spacers **30** may be used for centering and aligning the electrodes **24** and **28** of the electron gun **14**, however three for each electrode is a desirable number since six equally spaced contact areas or contact lines **50** are thereby provided on the inner wall of the neck **12** and the forces on each electrode are balanced. Each member **30** is welded to the electrode to be centered at the connecting portion **48** with the arms **44**, **46** extending outwardly from the body of the electrode and with the contact lines **50** of the ends of the arms extending in planes parallel to the longitudinal axis of the neck **12**. Thus narrow, but highly effective contact areas are provided by the arms **44**, **46** of the members **30** and the desired precision centering and support are achieved.

In operation of the tube, the electron gun **14** in the neck **12** of the envelope is shielded from the internal conductive coating **34** and the bulb **16** of the envelope by means of the focusing and shielding electrode **28**. Thus any cold emission electrons emitted in the neck or any other ions present in the bulb are prevented from passing to other parts of the tube. Only the desired electron beam passes through the aperture portion **38** in that electrode. An incidental advantage of the electron gun construction of the invention lies in the fact that the getters **32** are supported at the upper end of the neck of the envelope where more effective gettering action is achieved than if the getters were supported at the cathode end of the electron gun.

A modification of the invention is shown in Fig. 4 which is a plan view of an electrode **52** employing a modified centering and spacing means **54**. The spacers **54** are made of sheet metal or the like and, in this instance, comprise a base portion **56** having a single resilient fin-like arm **58** extending outwardly therefrom. In this embodiment also the arm has a considerable width and a very small length so that line contact areas are provided by the ends of the arms. To achieve accurate alignment the arm **58** of each support member **54** extends from the base **56** at substantially the same angle. A sufficient num-

ber of spacers 54 are welded to each electrode to provide, preferably, an even number of equally spaced pressure lines on the inner wall of the neck of an electron beam tube. Thus forces applied to each electrode are balanced and accurate centering and alignment are achieved.

It is to be understood that the principles of this invention may be applied to any type of electronic device wherein permanent and accurate support, centering and alignment are desired and where electrical contact between an electrode and another component, for example a conductive coating, may be achieved through the electrode support means.

This invention provides an electron gun structure having the principal advantages that (1) the second anode 28 is independently supported and centered within the tube neck in contact with the internal conductive coating 34, and (2) the second anode 28 and electrode 24 are supported by members which are flexible, yet provide permanent precision centering and alignment of the electrodes with respect to each other.

What is claimed is:

1. An electron discharge device comprising a cylindrical envelope portion having a predetermined axis, a tubular electrode within said envelope having an axis of symmetry, and means spring pressed to the inner surface of said cylindrical envelope portion for aligning said axis of symmetry with said predetermined axis, said means including a plurality of rectangular, flexible, vane-like members fastened to said electrode and having their outer edges parallel to the axis of symmetry of said tubular electrode.

2. An electron discharge device comprising a cylindrical envelope portion having a predetermined axis, a conductive coating on the inner surface of said envelope portion, a cylindrical electrode having an axis of symmetry within said envelope portion, and means for aligning said axis of symmetry of said electrode along said predetermined axis, said means including a plurality of V-shaped conducting members each having an arcuate-shaped base fastened saddle-like to said cylindrical electrode and having flexible rectangularly-shaped arms disposed substantially radially in the space between said envelope and said electrode, with the free edge of each arm parallel to said axis of symmetry of said cylindrical electrode, said free edge of each of said arms being spring pressed into contact with said conductive coating along a line parallel to said predetermined axis.

3. An electron discharge device comprising a cylindrical envelope portion having a predetermined axis, an electrode within said envelope portion and having an axis of symmetry, and means spring spressed to the inner surface of said cylindrical envelope portion for aligning said axis of symmetry with said predetermined axis, said means including a plurality of circumferentially spaced, rectangular, flexible, vane-like members fastened to said electrode and having their outer edges parallel to the axis of symmetry of said electrode.

4. An electron discharge device comprising a cylindrical envelope portion having a predetermined axis, an electrode within said envelope portion and having an axis of symmetry, and means spring pressed to the inner surface of said cylindrical envelope portion for aligning said axis of symmetry with said predetermined axis, said means including a plurality of circumferentially spaced, flexible, vane-like arms fastened to said electrode and extending into the space between said electrode and said envelope portion and having outer edges of substantial length parallel to said axis of symmetry.

5. The invention as in claim 4 wherein the length of each arm is greater than the radial spacing between said electrode and the inner surface of said cylindrical envelope portion.

6. The invention as in claim 4, wherein the length of each outer edge is greater than the length of each arm.

7. An electron discharge device comprising a cylindrical envelope portion having a predetermined axis, an electrode within said envelope portion and having an axis of symmetry, and means for aligning said axis of symmetry with said predetermined axis, said means including a plurality of circumferentially spaced, flexible, vane-like arms rigidly fastened to said electrode and extending into the space between said electrode and said envelope portion and having outer edges of substantial length parallel to said axis of symmetry and spring pressed toward the inner surface of said cylindrical envelope portion.

8. An electron discharge device comprising a cylindrical envelope portion having a predetermined axis, an electrode within said envelope portion and having an axis of symmetry, and means for aligning said axis of symmetry with said predetermined axis, said means including a plurality of circumferentially spaced, flexible, vane-like arms rigidly fastened to said electrode and extending into the space between said electrode and said envelope portion and having outer edges of substantial length parallel to said axis of symmetry and spring pressed toward the inner surface of said cylindrical envelope portion, said means providing the sole support for said electrode.

9. An electron discharge device comprising a cylindrical envelope portion having a predetermined axis, a tubular electrode within said envelope portion and having an axis of symmetry, and means for aligning said axis of symmetry with said predetermined axis, said means including a plurality of circumferentially spaced, flexible, vane-like arms rigidly fastened to said electrode and extending into the space between said electrode and said envelope portion and having outer edges of substantial length parallel to said axis of symmetry and spring pressed toward the inner surface of said cylindrical envelope portion, said means providing the sole support for said electrode.

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