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CATHODE RAY TUBE STRUCTURE

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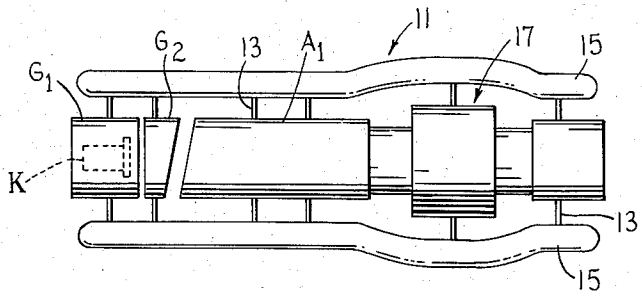


FIG. 1.

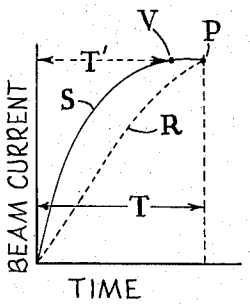


FIG. 2.

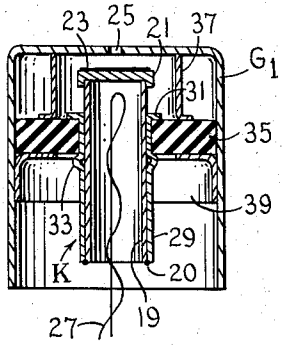


FIG. 3.

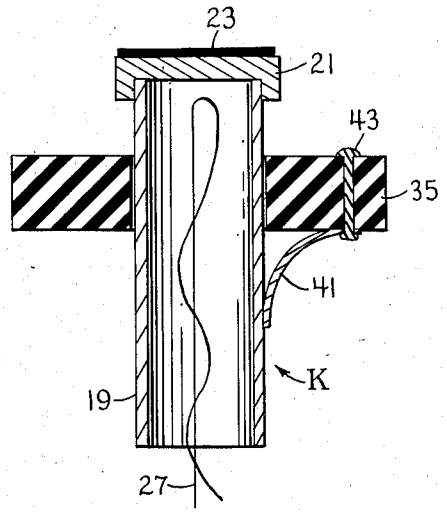


FIG. 4.

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CATHODE RAY TUBE STRUCTURE

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3 Claims. (Cl. 313—82)

This invention relates to electron discharge devices and more particularly to devices of the cathode ray type which employ thermionic cathodes.

A cathode ray tube generally includes a thermionic cathode, a control grid, an anode and a screen. The electrons emitted from the cathode are formed into a beam and are accelerated toward the screen by virtue of electric fields extending from the anode and other high voltage electrodes into the cathode region. A signal is usually developed across the control grid and cathode so that the beam current may be modulated in an appropriate manner. When the tube is energized, a considerable amount of time elapses before a steady state value of beam current or image brightness is achieved. This "warm-up" time is dependent upon many factors including the temperature versus emission characteristics of the cathode and the spacing between the control grid and cathode.

As heat is applied to the cathode, it tends to expand and move closer to the control grid. Therefore, it has been necessary to initially mount the cathodes farther from the control grid than is normally desired so that the final expanded position will provide the correct positioning. Such a structure increases the "warm-up" time since the electric field penetration, which is one of the determining factors of beam current, is less when the cathode is spaced farther from the control grid.

Accordingly, an object of the invention is to decrease the time interval necessary for steady state emission or brightness to be achieved in a cathode ray tube.

The cathode heater voltage and therefore the cathode temperature and emission are dependent upon the line voltage used to supply the tube circuitry. In tubes of the type described above, when the line voltage drops, the cathode temperature also drops. This factor, coupled with the contraction of the cathode and its attended increase in the spacing from the control grid, causes a drop in beam current and brightness.

Accordingly, another object of the invention is to stabilize beam current in a cathode ray tube under normal operating conditions.

The foregoing objects are achieved in one aspect of the invention by the provision of a cathode ray tube employing a cathode assembly formed to move relative to the control grid so that the cathode to grid spacing increases as the cathode temperature increases.

For a better understanding of the invention, reference is made to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a plan view of a cathode ray tube electrode mount;

Fig. 2 is a graphical representation of cathode ray tube emission characteristics under certain conditions;

Fig. 3 is a cross sectional view of a cathode and control grid assembly; and

Fig. 4 is a cross sectional view of another type of cathode assembly.

Referring to the drawings, a typical cathode ray tube mount **11** is shown comprising a plurality of axially aligned electrodes mounted relative to one another by pins **13** and insulating rods **15**. The electrons originating at the cathode K are formed into a beam and are controlled and accelerated by the G_1, G_2 and A_1 electrodes. The beam is electrostatically focused by lens assembly **17** and is then deflected over the screen (not shown) to produce the image.

The electrons emitted from thermionic cathode K are accelerated toward the screen of the tube by virtue of the electric fields created primarily by the G_2 and A_1 electrodes. If cathode K is moved closer to G_1, the effects of the electric fields cause an increase in the beam current, other factors remaining constant. Therefore, in order to decrease the "warm-up" time, it is advantageous to have cathode K initially mounted close to G_1 and constructed to allow movement progressively away from G_1 during the heating time interval until the desired spacing between these electrodes is reached to produce steady state emission when the cathode has reached operating temperature.

Referring to Fig. 2, curve R illustrates the beam current behavior of a conventional cathode structure during the time T necessary to reach a steady state beam current value at point P. Curve S, which represents an emission curve of a cathode structure of the type illustrated in one aspect of the invention, has a larger slope so that the steady state beam current is reached at point V in a considerably shorter period of time T'.

Fig. 3 shows one embodiment of a cathode structure K adapted to provide a beam current versus time characteristic of the type shown by curve S. The cathode comprises a cylinder **19** having a cap **21**, which may be made of nickel, positioned on one end thereof. An electron emissive material **23** is disposed on the top of cap **21** and positioned in spaced relationship from aperture **25** in cylindrical grid G_1. Electric fields provided by the G_2 and A_1 electrodes penetrate through aperture **25** to accelerate the electrons emitted from coating **23**. A resistance heater **27** is disposed within cylinder **19** to provide the heat necessary to facilitate cathode emission. Surrounding cylinder **19** is a sleeve **29** having a collar **31** and a rib **33** formed to facilitate cooperation with electrical insulating disk **35**. The bottom portions of cylinder **19** and sleeve **29** are welded or otherwise affixed to one another as indicated by the numeral **20**. Cathode K is positioned within cylindrical grid G_1 by means of spacer **37** and a retaining ring **39**, which may be welded to the wall of the grid.

Cylinder **19** and sleeve **29** may serve as a bi-metallic element operable to move the cap **21** and emissive coating **23** away from aperture **25** when the cathode becomes heated. The thermal coefficient of expansion of sleeve **29** is sufficiently greater than the thermal coefficient of expansion of cylinder **19** so that the resultant motion of the cylinder will be in the downward direction, Fig. 3. Satisfactory results have been obtained by using nickel iron alloys having different nickel contents for the cylinder and sleeve.

Fig. 4 illustrates another cathode structure capable of providing beam current versus time characteristics of the type illustrated by curve S in Fig. 2. In this construction, cylinder **19** is slidably mounted upon insulator **35** by means of a bi-metallic element **41**. A rivet **43** connects the element to insulator **35** at one end while the opposite end of element **41** may be affixed to the cylinder by welding. As cathode K becomes heated, the bi-metallic element moves cap **21** and emissive coating **23** away from the control grid. If desired, element **41** and cylinder **19** may combine to form a single bi-metallic

unit by fabricating element 41 from a material having a coefficient of expansion sufficiently greater than cylinder 19 so that the cathode may be properly moved during the "warm-up" period.

A cathode structure of the type described herein provides a short time interval for steady state emission and brightness characteristics to be reached in an electron discharge device in addition to providing means for stabilizing the beam current during normal operation of the tube by using cathode emission determining factors in a compensating manner. Beam current stability is achieved by movement of the cathode toward G_1 when the line voltage and therefore the cathode temperature decreases. This movement tends to increase the electric field penetration into the cathode area to thereby increase emission and offset the percentage of emission lost by the lowered cathode temperature.

Although several embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. A cathode ray tube comprising an anode, a cylindrical control grid having an aperture formed in one end thereof, a thermionic cathode, having emissive material, disposed within said grid in spaced relationship with said aperture, the material providing a prescribed amount of electron emission after a prescribed heating time interval, and a cathode supporting element operable to increase the spacing between said material and said grid during the heating time interval.

2. A cathode assembly for an electron discharge device comprising a cathode cylinder having a given thermal coefficient of expansion, a heater disposed within said cylinder, and a support parallel to the cylinder and connected therewith, said support having a thermal coefficient of expansion greater than said cylinder.

3. A cathode assembly for an electron discharge device comprising a cathode cylinder having a given thermal coefficient of expansion, a heater disposed within said cylinder, an electrical insulator spaced from the cylinder, and a sleeve having a coefficient of expansion greater than said cylinder and connected to one portion thereof, said sleeve being mounted upon said insulator intermediate said cylinder and said insulator.

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