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CATHODE-RAY TUBE

Filed Dec. 23, 1949

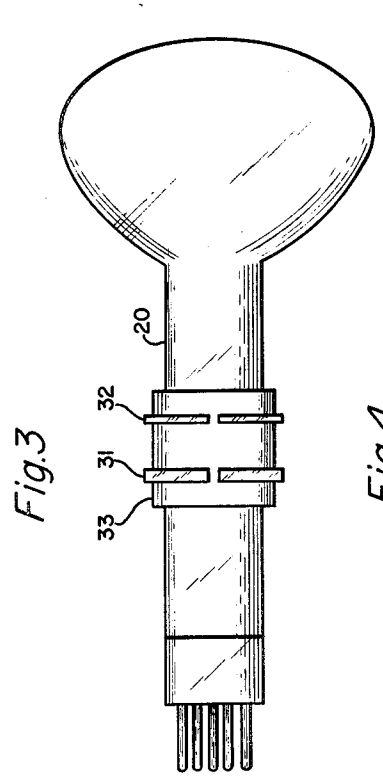


Fig. 3

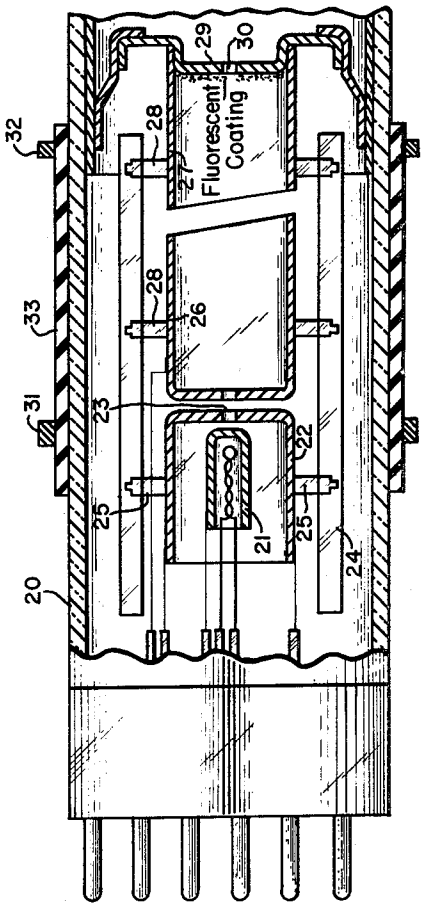


Fig. 4

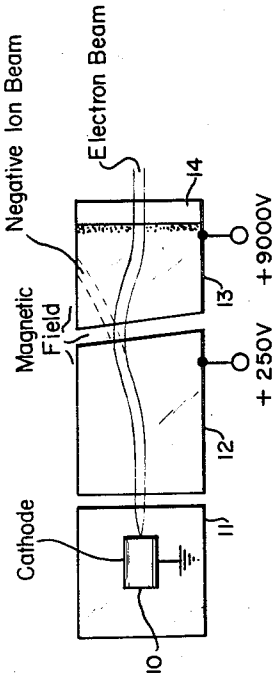


Fig. 1

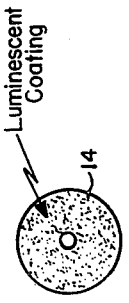


Fig. 2

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CATHODE-RAY TUBE

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4 Claims. (Cl. 313—81)

1

This invention relates to cathode-ray tubes and more particularly to cathode-ray tubes which include controlling structures commonly referred to as "ion traps" for preventing negatively charged ions within the tube from reaching the screen thereof.

It is well known that the beam developed within a cathode-ray tube includes, in addition to electrons, negative ions in appreciable quantities which, if allowed to reach the screen, contaminate it and give rise to undesirable black spots on the screen surface. It is also known that these negative ions are deflected to substantially the same extent as electrons by an electro-static field, but are relatively unaffected by a magnetic field. Cathode-ray tubes have been developed that utilize this principle for selectively deflecting the ions and electrons in the cathode-ray beam developed therein so that only the electrons reach the screen, the ions being deflected away from the screen to any suitable dissipating electrode.

It is usual in such types of cathode-ray tubes to provide a hollow cylindrical anode having an apertured disc over the end thereof remote from the cathode. Selective deflection of the electrons and ions in the cathode-ray beam developed in the tube is made to occur in the vicinity of this anode and in such a fashion that only the electrons pass through the aperture in the disc, the ions being deflected to the internal surface of the anode. It is extremely important in the adjustment of the selective deflection means that all the electrons in the beam pass through the aperture, for not only is the tube efficiency impaired if all the electrons do not pass through this aperture but, in addition, the electrons bombard the portion of the disc surrounding the aperture. The heat produced by this bombardment vaporizes the metal of the disc releasing gases which have a harmful effect on the operation of the tube. Moreover, some of this vaporized metal may be deposited on the screen of the tube causing serious contamination.

It has been usual practice heretofore in the art to adjust the selective deflection means until the screen of the cathode-ray tube is excited with maximum intensity. There are many objections to this practice. In the first place, it is awkward in most television receivers to adjust the selective deflection means (which is usually situated on the neck of the cathode-ray tube), and at the same time observe the screen of the tube for maximum intensity. Moreover, since it is usual practice today to derive the high exciting potential for the anode of the cathode-ray tube from the scanning system associated therewith, a full raster must be observed as opposed to a single spot, and it is extremely difficult for the human eye to determine when the intensity of the raster has reached an exact maximum intensity.

2

For these reasons proper adjustment of the selective deflection means of a cathode-ray tube to a setting whereby no ions, yet substantially all the electrons in the cathode-ray beam, reach the screen of the tube has been a problem that prior to the present invention was considered insoluble. The present invention provides a simple and inexpensive means whereby an operator may determine conveniently and with a high degree of accuracy the exact setting of the selective deflection means at which all the electrons in the cathode-ray beam developed within the tube pass through the aperture in the anode disc.

It is, accordingly, an object of this invention to provide an improved cathode-ray tube of the type which includes a selective deflection arrangement to separate the ions from the electrons in the cathode-ray beam developed within the tube, and in which means is provided for indicating the exact setting of the selective deflection arrangement for proper operation of the tube.

The features of this invention which are believed to be new are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof may best be understood by reference to the following description when taken in conjunction with the accompanying drawing, in which;

Figure 1 is a schematic diagram of a typical ion trap arrangement for a cathode-ray tube to which the present invention may be applied,

Figure 2 shows another view of one of the components of the arrangement of Figure 1,

Figure 3 shows a cathode-ray tube with a typical adjustable selective deflection arrangement associated therewith for ion separation, and,

Figure 4 shows a section of the tube of Figure 3 incorporating the present invention.

The arrangement illustrated in Figure 1 includes a cathode 10, a cylindrical control electrode 11 to which a variable negative potential may be applied, a cylindrical accelerating electrode 12 to which a positive potential (for example 250 volts) may be applied, and a cylindrical first anode 13 to which a positive potential (for example 9,000 volts) may be applied. The

adjacent end portions of the accelerating electrode 12 and anode 13 are shaped so that a tilted slot appears therebetween. The end of anode 13 remote from cathode 10 is enclosed by a disc 14 having a central aperture. Due to the fact that the slot between accelerating electrode 12 and anode 13 is tilted, an electro-static field is set up between these two electrodes having a component transverse to the longitudinal axis of the arrangement. This field acts to "bend" the cathode-ray beam derived from cathode 10 and direct it to the inside surface of the anode 13. A magnetic field is set up in the vicinity of these electrodes, and this magnetic field is adjustable to restore the path of travel of electrons only, thereby to direct the electrons as distinguished from the ions of the cathode-ray beam to the central aperture in disc 14.

In accordance with the invention and as shown in Figure 2, the surface of disc 14 facing the cathode is coated with a luminescent substance. This surface is readily observable through the tilted slot between the electrode 12 and anode 13. Should any of the electrons in the beam impinge on the coated surface of the disc 14 instead of passing through the aperture, this surface becomes excited and glows brilliantly. It is merely necessary to adjust the magnetic field until the inside surface of disc 14 no longer emits any light, and when this occurs all the electrons in the beam pass through the aperture and the correct setting of the magnetic field is realized.

It is, therefore, no longer necessary for an operator to be in the awkward position of attempting to view the screen of the tube while making this adjustment. Nor need he rely on maximum brightness of the raster as an indication of proper adjustment. With the cathode-ray tube of the present invention, the operator need merely adjust the magnetic field until the coated side of disc 14 no longer fluoresces, and when this occurs the magnetic field is adjusted to a highly critical setting for optimum operation of the tube.

The process of applying the luminescent coating to the surface of disc 14 is extremely simple. Before the disc is placed in the cylindrical portion of anode 13, the surface may first be coated with water glass, a mask may then be placed over the aperture so that no fluorescent particles adhere to the inside edge of the aperture since this would produce a "ragged edge" to the cathode-ray beam due to charging up of the particles, fluorescent powder sprinkled over the water glass, and the mask removed. It has been found preferable to use zinc silicate activated with manganese as the fluorescent powder, since such powder does not act to contaminate the cathode as is sometimes the case when a sulphide is used. However, it is to be distinctly understood that the invention is not limited to the use of any particular fluorescent material, since any material that has the property of becoming luminescent upon impingement of an electron beam may be utilized. It is also desirable that the slot between the electrode 12 and anode 13 be of the order of 6 millimeters in width to allow a clear view of the coated surface of disc 14.

The cathode-ray tube illustrated in Figures 3 and 4 includes an envelope 20. The envelope is of usual shape and has an elongated neck portion and an enlarged portion closed at its outer end to provide a viewing window for the tube. The inner surface of the window is covered with a fluorescent coating which forms the image screen of the tube. A gun structure is enclosed in the

neck portion and includes a cylindrical cathode 21 supported centrally within a cylindrical control electrode 22, this latter electrode having the form of a metallic cup with an aperture 23 aligned with the emitting surface of the cathode.

A plurality of glass supporting rods 24 are secured to the control electrode 22 by radially projecting metal lugs 25. A cylindrical accelerating electrode 26 and a cylindrical anode 27 are supported in coaxial alignment with the electrode 22 by means of a plurality of lugs 28 sealed into the supporting rods 24. The end of anode 27 remote from the cathode is closed by means of a disc 29 which is provided with a central aperture 30. In accordance with the invention, the surface of disc 29 facing the cathode is coated with a luminescent material capable of being excited upon impingement by the electron beam. In addition, it may be desirable also to coat the inside wall of the anode adjacent the disc with the material to provide an indication for wide adjustment of the beam.

The electrode 26 and anode 27 are spaced and shaped to define a gap therebetween extending at an oblique angle with respect to the longitudinal axis of the gun. As previously pointed out, the electro-static field produced by these electrodes acts to "bend" the beam away from this longitudinal axis.

A pair of transverse magnetic fields is provided on opposite sides of the gap between cylinders 26 and 27 which, in conjunction with the deflection provided by the electro-static field, give rise to a selective deflection of the electrons and ions of the cathode-ray beam. These magnetic fields are produced by a pair of permanent magnetized resilient metallic rings 31 and 32 positioned on the neck portion of the envelope on opposite sides of the gap. The rings 31, 32 are split and mounted on a resilient support 33 which is slidably and rotatably mounted on the neck. With this construction, it is possible to adjust the angular positions of the rings to provide the desired control on the cathode-ray beam. The rings 31 and 32 are magnetized and disposed in such a manner that they produce transverse magnetic fields within the tube in opposite directions. The ring 31 sets up a magnetic field which acts to redirect the electrons in the cathode-ray beam back towards the longitudinal axis of the gun to compensate for the effect of the electro-static field on the electrons. The ring 32 sets up a magnetic field which acts to correct for over-compensation of the magnetic field of ring 31. These magnetic fields have no material effect on the ions on the cathode-ray beam, and these ions are directed by the electrostatic field to the inside surface of the cylindrical anode 27.

When the magnetic fields are not properly adjusted, the flourescent coating on the disc 29 glows brilliantly and may be observed through the slot between the cylinders 26 and 27. The rings 31 and 32 may be manually adjusted until their magnetic fields are such that all the electrons in the electron beam are directed through the aperture 30 to the image screen. When this occurs, the surface of disc 29 ceases to glow indicating that a proper setting has been reached.

Although the present invention has been described as applied to a particular type of ion trap in a particular type of cathode-ray tube, it is clearly not limited thereto. The invention finds ready utilization in all types of cathode-ray tubes using selective deflection means to separate the ions and electrons in the cathode-

ray beam developed therein, and in which the electrons are directed through a restricted aperture in an electrode contained in the tube.

Therefore, while a particular embodiment of the invention has been shown and described, modifications may be made and it is intended in the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. An ion-trap type of cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a cathode-ray beam and for directing said beam to a target; a hollow electrode spaced from said emitter and so positioned that the end thereof facing said emitter is observable through said transparent portion of said envelope; an apertured transverse disc included in said electrode remote from said end thereof and extending across the intended path of said beam; a coating of luminescent material on at least a portion of the internal surface of said electrode for providing a radiation visible through said end of said electrode whenever said beam is off its intended path; and means for deflecting said beam to adjust the path thereof relative to said intended path.

2. An ion-trap type of cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a cathode-ray beam and for directing said beam to a target; a hollow electrode spaced from said emitter and so positioned that the end thereof facing said emitter is observable through said transparent portion of said envelope; an apertured transverse disc included in said electrode enclosing the opposite end thereof and extending across the intended path of said beam; a coating of luminescent material on at least a portion of the internal surface of said electrode for providing a radiation visible through said end of said electrode facing said emitter whenever said beam is off its intended path; and means for deflecting said beam to adjust the path thereof relative to said intended path.

3. An ion-trap type of cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a cathode-ray beam and for directing said beam to a target; a hollow electrode spaced from said emitter and so positioned that the end thereof facing said emitter is observable through said transparent portion of said envelope; an apertured transverse disc included in said electrode remote from said end thereof and extending across the intended path of said beam; a coating of luminescent material on the surface of said disc facing said emitter for providing a radiation visible through said end of said electrode whenever said beam is off its intended path; and means for deflecting said beam to adjust the path thereof relative to said intended path.

4. An ion-trap type of cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a cathode-ray beam and for directing said beam to a target; a hollow electrode spaced from said emitter and so positioned that the end thereof facing said emitter is observable through said transparent portion of said envelope; an apertured transverse disc included in said electrode hidden from direct view through said envelope and extending across the intended path of said beam; a coating of luminescent material on the surface of said disc facing said emitter for providing a radiation visible through said end of said electrode whenever said beam is off its intended path; and means for deflecting said beam to adjust the path thereof relative to said intended path.

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