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CATHODE-RAY TUBE

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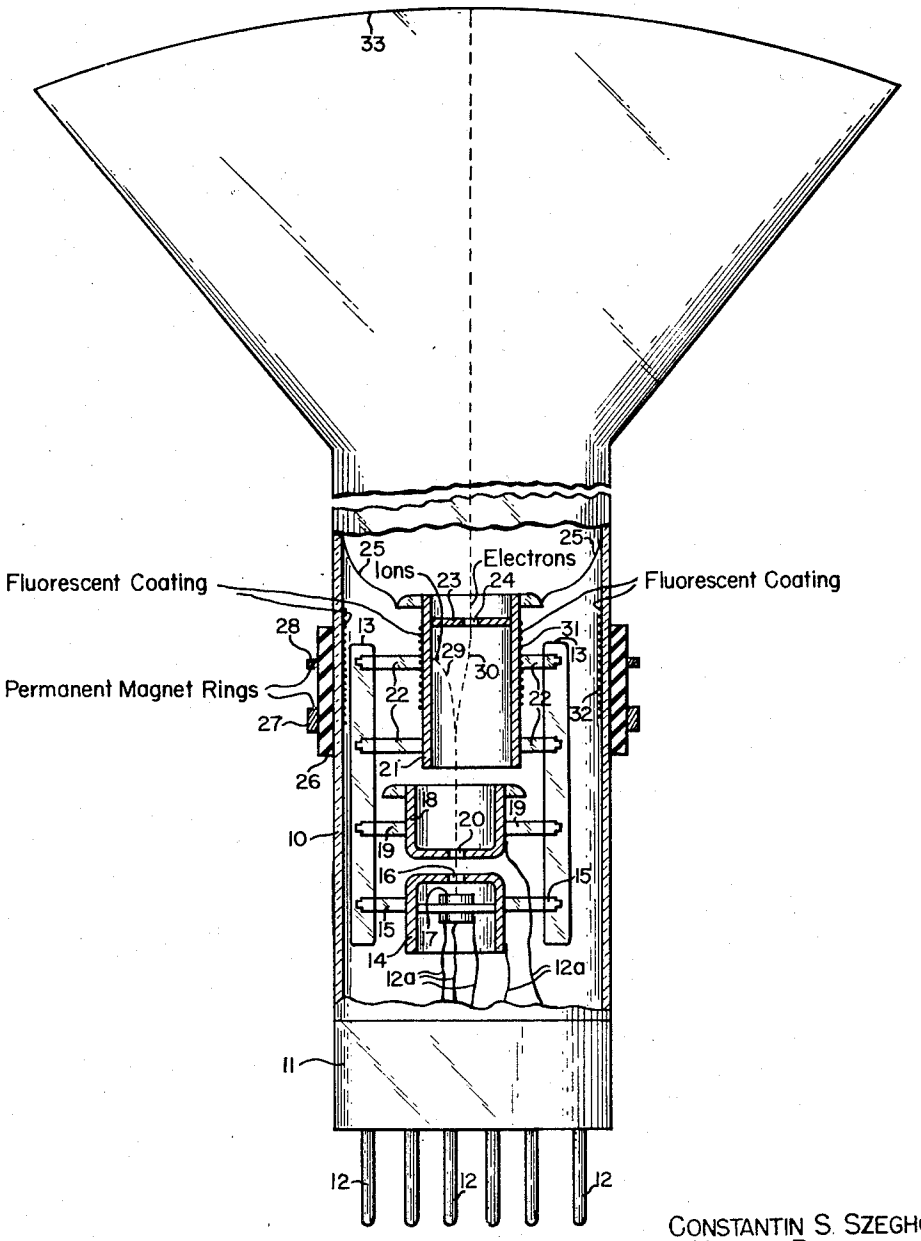

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CATHODE-RAY TUBE

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7 Claims. (Cl. 313—85)

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This invention relates to arrangements for indicating beam alignment in cathode-ray tubes and, although it is subject to general application to cathode-ray tubes, it is especially suited for use in those tubes which include controlling structures commonly referred to as "ion traps" for preventing negatively charged ions within the tube from reaching the target area of the screen thereof. For convenience, the invention will be described in detail in connection with such an ion trap type of tube.

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 of the mixed cathode-ray beam so that only the electrons are permitted to reach the screen, the ions being deflected away from the screen to be collected by any suitable dissipating electrode.

It is usual in such cathode-ray tubes to provide a hollow tubular anode having an apertured disc enclosing the end thereof remote from the cathode. Selective deflection of the electrons and ions in the cathode-ray beam developed in the tube occurs 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 that all the electrons in the beam pass through the disc aperture, for not only is the tube efficiency impaired if all the electrons do not pass through this aperture but also, some of the electrons bombard the disc and the heat produced thereby may vaporize the metal of the disc destroying it and 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, causing serious contamination.

It has been usual practice in the art to adjust one or more magnets, employed to effect the selective deflection of electrons as distinguished from ions, until the screen of the cathode-ray tube is excited with maximum intensity, but there are many objections to this practice. In the first place, it is awkard in many television receivers to adjust the deflecting magnet, which is

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usually situated on the neck of the cathode-ray tube, and at the same time observe the screen 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 exceedingly difficult for the eye to determine when the intensity of the raster has reached its maximum intensity.

Copending application Serial No. 134,725, filed December 23, 1949, in the name of C. S. Szegho, entitled "Cathode-Ray Tube" and assigned to the present assignee, provides a simple and inexpensive means whereby an operator may determine conveniently and with a high degree of accuracy the exact setting of the deflecting magnet at which all the electrons in the cathode-ray beam developed within the tube pass through the apertured disc of the tubular anode. This is accomplished by coating the disc surface facing the cathode with fluorescent material so that whenever the electron beam does not pass through the aperture it impinges on the fluorescent coating causing excitation thereof. The tube is so constructed that the resulting luminescence of the coating may be observed through a transparent portion of the neck. Accordingly an operator may merely adjust the deflecting magnet until the luminescence is extinguished at which time the electron beam is fully directed through the aperture.

Applicants have discovered that it is unnecessary to deposit the fluorescent coating on a surface that is subject to direct impingement by the electron beam; instead it may be placed on a surface which responds to reflection or other indirect secondary emissive effects of the electron beam. For example, highly satisfactory results have been achieved with a fluorescent coating on the external surface of the tubular anode, or on the internal surface of the adjacent envelope portion of the cathode-ray tube. The location of the fluorescent coating on such surfaces is highly advantageous. Since there is no direct impingement of the fluorescent coating by the electron beam no deleterious gases are produced within the tube as sometimes occurs when the beam is allowed to impinge directly on such coatings. Moreover, the coating is readily observable irrespective of the axial spacing of the electron-gun components, and since the coating does not directly surround the beam aperture of the anode disc, it can not cause the electron beam to have ragged edges.

It is, accordingly, an object of this invention to provide a cathode-ray tube having an improved arrangement for indicating whether or not the electron beam thereof is properly aligned.

It is another object of the invention to provide in a cathode-ray tube of the type which includes a selective deflection system to separate ions from the electrons of the cathode-ray beam, improved means for indicating the exact adjustment of the selective deflection system required 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 the single figure represents a cathode-ray tube of the above-described type which incorporates the present invention.

The cathode-ray tube illustrated in the drawing is similar in many respects to that disclosed in copending application Serial No. 156,746, entitled "Electron Gun for Cathode-Ray Tubes" filed April 19, 1950, in the name of Phillips et al. and assigned to the present assignee. This tube comprises a transparent neck section 10 in which an electron-gun structure is mounted. The neck may be terminated in the usual base 11 through which a plurality of pins 12 extend to be electrically connected to various elements of the electron gun, by way of electrode leads 12*a*, to establish these elements at desired operating potentials. The gun elements are supported by glass rods 13 which extend longitudinally within the tube and are held securely therein by any suitable means. More specifically, the electron gun includes a tubular control electrode 14 supported by lugs 15 extending into supporting rods 13 and having a centrally located aperture 16 in its upper surface. A usual cathode structure 17 is mounted within electrode 14 with its upper activated surface aligned with aperture 16 and spaced therefrom by a fixed axial distance determined in any well-known manner.

A second tubular electrode 18 is secured to supporting rods 13 by means of lugs 19. This electrode is mounted coaxially with control electrode 14 and has a central aperture 20 in its lower transverse surface aligned with aperture 16. A tubular anode electrode 21 facing electrode 18 is secured to supporting rods 13 by means of lugs 22 and has a transverse wall 23 closing its upper end and having a central aperture 24 formed therein. The electrode 21 may be established at a desired operating potential by means of terminal connections 25 which connect, in well-known manner, to the internal conductive surface of the tube (not shown).

Anode 21 is mounted coaxial with the longitudinal axis of the tube, whereas electrodes 14 and 18 are mounted on a common axis parallel to the longitudinal axis of anode 21 and off-set therefrom by a preselected amount which is small compared with the diameters of electrodes 14, 18 and 21. A tubular member 26 is mounted on the external surface of neck 10 and supports a pair of coaxially spaced permanent magnet rings 27, 28. This member may be moved longitudinally or may be rotated on the neck surface for reasons to be described.

In operation of the tube, anode 21 is established at a fixed positive potential that is large relative to the potential of electrode 18. The difference in potential between electrodes 18 and 21 gives rise to an electro-static field therebetween, and since these electrodes are off-set with respect to one another, the electro-static field deflects the mixed beam of electrons and ions, originating at cathode 17 and projected through apertures 16 and 20, to the inside surface of electrode 21 along a path such as represented by the broken-construction line 29. Under these conditions, neither electrons nor ions are directed to aperture 24 in disc 23.

The permanent magnet ring 27 is oriented to produce a field within neck 10 to direct solely the electrons of the mixed beam transversely of disc 23 and through aperture 24 to a fluorescent screen 33 deposited on the end wall of the cathode-ray tube, these electrons being directed along a path such as that indicated by broken-construction line 30. It is preferable in this type of construction to include the second permanent magnet ring 28 which produces a magnetic field in the opposite sense to the field of magnet 27 to compensate for any over-shooting effect of the field of magnet 27 and to insure that the electron beam emerging from aperture 24 is directed along the longitudinal axis of the tube. Since member 26 may be rotated about and moved longitudinally on neck 10 the fields of magnets 27 and 28 may be adjusted until the desired deflection of the electron beam through aperture 24 is obtained.

In accordance with the invention, a coating of fluorescent powder is placed on a surface which is not subject to direct impingement of the electron beam. It may be applied, for example, to the external peripheral surface of electrode 21, to a portion of the inner wall of neck 10 surrounding the gun, or to any structural component of the tube in the vicinity of the gun that may intercept electrons present whenever the beam is incorrectly aligned with respect to its intended path. In the illustrated embodiment a coating 31 of fluorescent powder is provided on the external periphery of tubular electrode 21, and a further coating 32 may be deposited on the internal surface of neck section 10 adjacent electrode 21. It has been found that with such fluorescent coatings a highly critical indication is given whenever any portion of beam 30 impinges on the internal surface of electrode 21 due to mis-adjustment of magnet rings 27, 28. The exact reason for the excitation of the fluorescent coatings is not completely understood at present, but it is believed to be due to the effect of electrons reflected from the interior of electrode 21. The luminescence of these coatings may be readily observed through the transparent neck section 10. To achieve proper operation, sleeve 26 is rotated and/or moved axially to adjust the effective field of the permanent magnet rings until these coatings no longer emit any light, which occurs when all the electrons in the beam pass through the aperture 24. These coatings provide a highly accurate and sensitive indication of any misalignment of electron beam 30, and glow brilliantly whenever any portion of this beam impinges on the internal surface of disc 23 or other internal portion of electrode 21.

With the aforedescribed arrangement the indication as to beam alignment is conveniently observable through transparent neck section 10. Since there is no direct impingement of the indicator coating by the electron beam, no deleterious gases are formed which might be the case should such direct impingement occur. Moreover, since

the coating is not applied to disc 23, there is no possibility of it giving rise to ragged edges to the electron beam.

In a constructed embodiment of the invention it was found preferable to deposit the fluorescent material on the external surface of electrode 21 and on the internal wall of neck portion 10, as shown in the drawing. However, the invention is clearly not limited to any particular location of the coating nor is it essential that more than one surface be coated inasmuch as an adequate indication of beam alignment may be obtained by utilizing a single surface as an indicator. The coating may comprise any suitable substance capable of luminescence by electron activation and may be applied to the selected surface in any well-known manner.

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 whether they be of ion-trap type or not. 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 may fall within the true spirit and scope of the invention.

We claim:

1. A cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a beam to be directed along a given path to a target; an electrode having a portion disposed across said path and provided with an aperture through which said beam is to pass; and a coating of luminescent material on a surface effectively shielded from direct impingement by said beam but subject to be excited when said beam impinges upon the internal surface of said electrode, the resulting luminescence of said first-mentioned surface being observable through said transparent portion.

2. A cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; a plurality of electrodes for forming electrons issuing from said emitter into a beam directed along a given path to a target and for controlling the intensity of said beam, at least one of said electrodes having a portion disposed across said path and provided with an aperture through which said beam is to pass, said envelope and said electrodes having surfaces viewable through said transparent portion of said envelope and effectively shielded from direct impingement by said beam; and a coating of luminescent material on at least one of said surfaces subject to be excited when said beam impinges upon the interior surface of said one electrode.

3. A cathode-ray tube comprising: an enclosing envelope having a transparent portion with an internal surface; an electron emitter; means for forming electrons issuing from said emitter into a beam directed along a given path to a target; an electrode having a portion disposed across said path and provided with an aperture through which said beam is to pass, and further having an external surface; a coating of luminescent material on at least one of said first- and second-mentioned surfaces observable through said transparent portion to be excited when said beam impinges upon the internal surface of said electrode; and adjustable means for deflecting said beam transversely of said portion of said electrode to direct said beam through said aperture.

4. A cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a beam directed along a given path to a target; an electrode having a portion disposed across said path and provided with an aperture through which said beam is to pass; a coating of luminescent material on the external surface of said electrode to be excited when said beam impinges on the internal surface thereof and the resulting luminescence of said coating being observable through said transparent portion; and adjustable means for deflecting said beam transversely of said portion of said electrode to direct said beam through said aperture.

5. A cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a beam directed along a given path to a target; an electrode having a portion disposed across said path and provided with an aperture through which said beam is to pass; and a coating of luminescent material on the external surface of said electrode to be excited when said beam impinges on the internal surface thereof and the resulting luminescence of said coating being observable through said transparent portion.

6. A cathode-ray tube comprising: an enclosing envelope having a transparent portion with an internal surface; an electron emitter; means for forming electrons issuing from said emitter into a beam directed along a given path to a target; an electrode having a portion disposed across said path and provided with an aperture through which said beam is to pass, and further having an external surface; a coating of luminescent material on at least one of said first- and second-mentioned surfaces observable through said transparent portion to be excited when said beam impinges upon the internal surface of said electrode; electro-static beam-deflection means for deflecting said beam transversely of said portion of said electrode to direct said beam away from said aperture; and adjustable magnetic beam-deflection means for deflecting said beam transversely of said portion of said electrode in the opposite sense to said electro-static beam-deflection means to direct said beam through said aperture.

7. A cathode-ray tube comprising: an enclosing envelope having a transparent portion; an electron emitter; means for forming electrons issuing from said emitter into a beam directed along a given path to a target; a tubular electrode having a disc portion disposed across said path and provided with an aperture through which said beam is to pass; a coating of luminescent material on the external peripheral surface of said electrode observable through said transparent portion to be excited when said beam impinges upon the internal surface of said electrode; electro-static beam-deflection means for deflecting said beam transversely of said disc portion of said electrode to direct said beam away from said aperture; and adjustable magnetic beam-deflection means for deflecting said beam transversely of said disc portion of said electrode in the op-

posite sense to said electro-static beam-deflection means to direct said beam through said aperture.

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