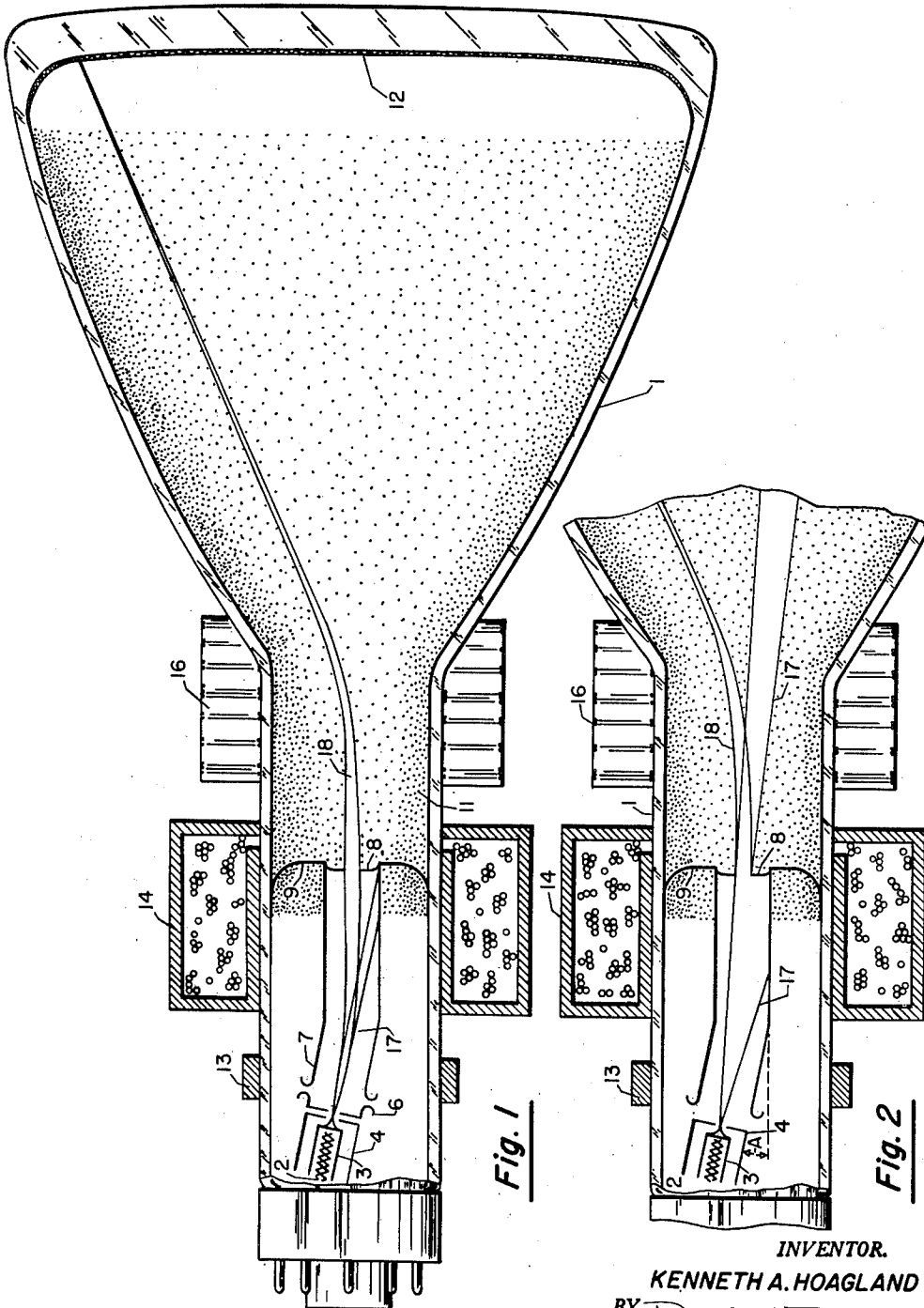


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ION-TRAP CATHODE-RAY TUBE

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## ION-TRAP CATHODE-RAY TUBE

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This invention relates to cathode-ray tubes and more particularly to the ion trap used in magnetically deflected cathode-ray tubes.

It is known to employ a bent electrode in the electron gun of a cathode-ray tube as a means for trapping the negative ions emitted by the cathode and control grid. Heretofore the so-called bent-gun type ion-trap has resulted in an unwieldy and impractical structure from the commercial standpoint.

It is one object of my invention to obtain an improved cathode-ray tube.

A second object is to obtain a bent-gun ion-trap type tube of the same size and shape and having the same deflection and focussing characteristics as a straight-gun tube.

Other objects will be apparent from the specifications and drawings, in which:

Figure 1 is a cross-sectional view of a cathode-ray tube embodying this invention and showing the operating electron and ion beams.

Figure 2 shows, in cross-sectional view, a cathode-ray tube having a prior art type of electron gun to illustrate the nature of operation thereof.

Figure 1 shows a cathode-ray tube 1 containing an electron gun comprising a heater 2 inside a cathode thimble 3, which has an electron emissive coating on a portion thereof and is partially or completely enclosed within a control grid electrode 4. Adjacent the control grid 4 is a first anode or screen grid electrode 5, also referred to and known as the second grid, which has the shape of a shallow cup and is preferably of the type disclosed in copending U. S. application Serial No. 91,714, by Pohle et al. An electrode 7, which is sometimes known as a second anode but which may be properly identified simply as anode, completes the electron gun structure.

As may be seen in Figure 1 of the drawing, the control grid 4 and screen grid 5 have the same diameter as the anode 7.

The anode 7 has an aperture disc 8 near the outer end thereof, i. e. the end more distant from the screen grid 5. The opening in the disc 8 is generally termed the limiting aperture. The end of the anode 7 adjacent the disc 8 is partially supported by a device 9 known as a spider, which has spring fingers bearing on an electrically conductive coating 11 and making electrical contact therewith. This coating 11 is applied to the walls of the cathode-ray tube 1 and extends from approximately the ends of the fingers of the spider 9 to the large end of the cathode-ray tube 1, near the fluorescent screen 12.

Other components essential to the normal operation of the cathode-ray tube 1 but not usually constructed integrally therewith are the ion-trap magnet 13, the focus coil 14 and the deflection yoke 15.

In operation, an electric current passing

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through the heater 2 causes heat, thereby raising the temperature of the emissive coating on the cathode 3 to the temperature at which electrons are emitted. Negative ions are also emitted along with the electrons. There is reason to believe that at least a portion of these ions originate at the cathode 3 due to the chemical breakdown of the emissive material, and the present invention will be illustrated with reference to these ions.

Since these ions are emitted along with the electrons and have the same electrical charge, they react to electric fields in the same way as electrons. However, since the mass of an ion is many times greater than that of an electron, the ions are not deflected by magnetic fields nearly as much as are the electrons. The ions emitted from the cathode 3 are constricted into a narrow bundle and pass through the aperture in the control grid 4 after which the bundle starts to spread out. Because of the electric field between the screen grid 5 and the anode 7, a partial focussing action is exerted on the ions which restricts them to a comparatively small bundle 17. Substantially all of the ions in this bundle are caught by the side of the anode 7 while the electrons forming a beam 18 are deflected by the ion-trap magnet 13 and pass out through the limiting aperture in the disc 8 to be focussed by the focussing coil 14 and deflected by the deflection yoke 15.

Figure 2 illustrates the operation of a prior art type of cathode-ray tube in which the ion-trapping occurs in the electrode following the control grid. In this case the tube is a "triode type," i. e. there is no screen grid so that the anode 7, corresponding to the anode 7 in Figure 1 is the electrode following the control grid 4. All of the components in Figure 2 are labelled with the same reference characters as similar components in Figure 1.

It may be seen in Figure 2 that, without the partial focussing action of the screen or second grid 5, the ion beam 17 spreads over a much larger angle. Some of the ions go through the limiting aperture in the disc 8 and strike the screen 12 (Figure 1) causing the well-known ion-blemishes.

In order to prevent these blemishes in this cathode-ray tube it has heretofore been necessary either to increase the length of the barrel of the anode 7, which results in a greater overall length for the tube, or to increase the angle A of the bend, which necessitates a thicker neck for the cathode-ray tube. Both of these solutions are undesirable because of a strong commercial tendency to use the smallest possible cathode-ray tube commensurate with a desired screen area.

The term "magnetically deflected tube" as used herein refers to the type cathode ray tube constructed for and intended to be used with additional magnetic beam deflection means as contrasted, for instance, with electrostatic type de-

flection tube. The term "magnetically focussed tube" means that tube constructed for and intended to be used with magnetic focussing means for the electron beam, although it is contemplated that some electrostatic focussing may also be involved, as contrasted with tubes having built in electrostatic focussing means.

I have described this invention in terms of a specific embodiment, but it will be apparent to those skilled in the art that it is possible to make modifications within the scope of the following claims.

What is claimed is:

1. A magnetically focussed, magnetically deflected cathode-ray tube comprising a cathode; a control grid; a screen grid; a fluorescent screen; and a tubular anode, said tubular anode having an axial bend with the tubular portion on one side of said bend directed substantially at the center of said screen and the tubular portion on the other side of said bend aligned substantially coaxially with said cathode, control grid and screen grid.

2. A magnetically focussed magnetically deflected cathode-ray tube comprising a straight-necked vessel containing a cathode; a control grid; a screen grid; a fluorescent screen; and a tubular anode, said tubular anode having an axial bend with the tubular portion on one side of said bend substantially in axial alignment with the longitudinal axis at said tube and the tubular portion on the other side of said bend aligned substantially coaxially with said cathode, control grid and screen grid.

3. A magnetically focussed magnetically deflected cathode-ray tube comprising a cathode; a control grid; a shallow, cup-like screen grid electrode having a substantially circular end portion with a central aperture therein, said cathode, control grid and screen grid having a common axis; said tube having a fluorescent screen; and an anode composed of two substantially tubular portions having intersecting axes, the axis of one of said tubular portions being directed at said screen and said other tubular portion being coaxial with said cathode, control grid and screen grid.

4. A magnetically deflected cathode ray tube comprising an evacuated vessel having a bulb portion and a straight cylindrical neck portion, an electron gun mounted in said neck portion, said gun comprising a cathode, a control grid, a second grid, and a tubular anode arranged in order along the path traversed by the electrons emanating from said cathode, said anode having a centrally apertured conducting disk mounted transversely therein, said electron gun being positioned in said neck portion so that a straight line from the center of said cathode through the center of said aperture intersects the axis of said neck at an angle.

5. A magnetically deflected cathode ray tube comprising an evacuated vessel having a bulb portion, an end wall on said wall portion and a straight cylindrical neck portion opposite said end wall, said neck portion having a conductive coating over a portion of the inside wall thereof with the axis of said neck being substantially perpendicular to the plane of said end wall, an electron gun mounted in said neck portion, said gun comprising a cathode, a control grid, a second grid and a tubular anode having a centrally apertured disk transversely mounted therein, the aperture in said disk being coaxial with said neck portion, said electrodes being arranged in order along the path traversed by electrons ema-

nating from said cathode, said electron gun being positioned in said neck so that a line from the center of said cathode coaxial with said control grid and said second grid intersects at an angle a line coaxial with said neck through the center of said aperture.

6. A tube in accordance with claim 4, in which said control grid is closer to the side wall of said neck portion than said conducting disc in said anode.

7. A magnetically deflected cathode ray tube comprising an evacuated vessel having a bulb portion and a straight cylindrical neck portion, an electron gun mounted in said neck portion, said gun comprising a cathode, a control grid, a second grid and a tubular anode arranged in order along the path traversed by the electrons emanating from said cathode, said anode having an apertured conducting disc mounted transversely therein, said second grid and said anode having substantially the same diameter, said electron gun being positioned in said neck portion so that a straight line from the center of said cathode through the center of said aperture intersects the axis of said neck at an angle.

8. The tube in accordance with claim 7, in which said control grid and said second grid have tubular portions, said tubular portions being of substantially the same diameter as said anode.

9. A magnetically deflected cathode ray tube comprising an evacuated vessel having a bulb portion including a target and having a straight cylindrical neck portion, an electron gun mounted in said neck portion, said gun comprising a cathode; a control grid; a second grid; and a tubular anode arranged in order along the path traversed by the electrons emanating from said cathode, said anode having an apertured conducting disc mounted transversely therein, said electron gun being positioned in said neck portion so that a straight line from the center of said cathode through the center of said aperture intersects the axis of said neck at an angle, said second grid and said anode providing an electrostatic focusing field therebetween to partially focus ions and electrons produced by said gun, into a beam; a magnet located adjacent the path traversed by said electrons and producing a magnetic field to deflect the partially focused beam of electrons; and means providing a second focusing field in the region of said aperture to focus only said electron beam on said target.

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