

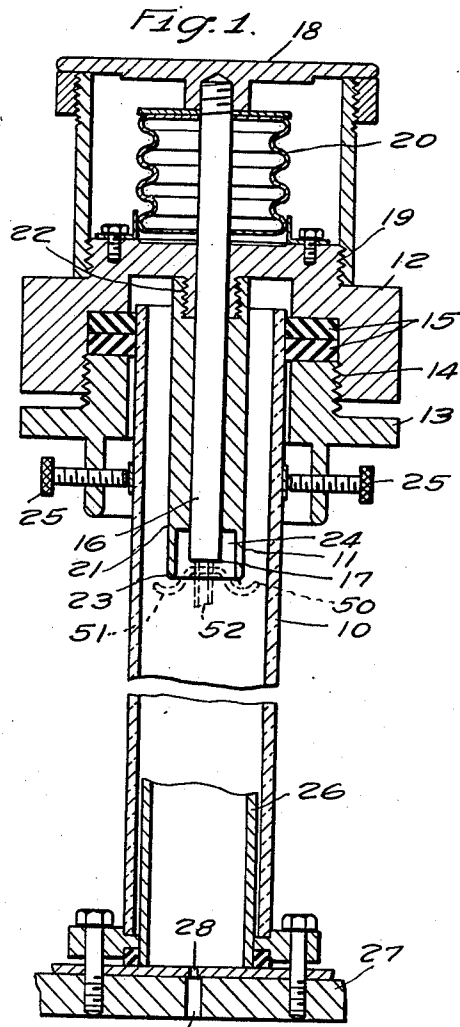
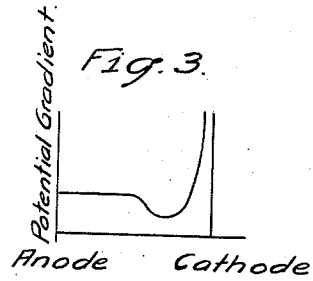
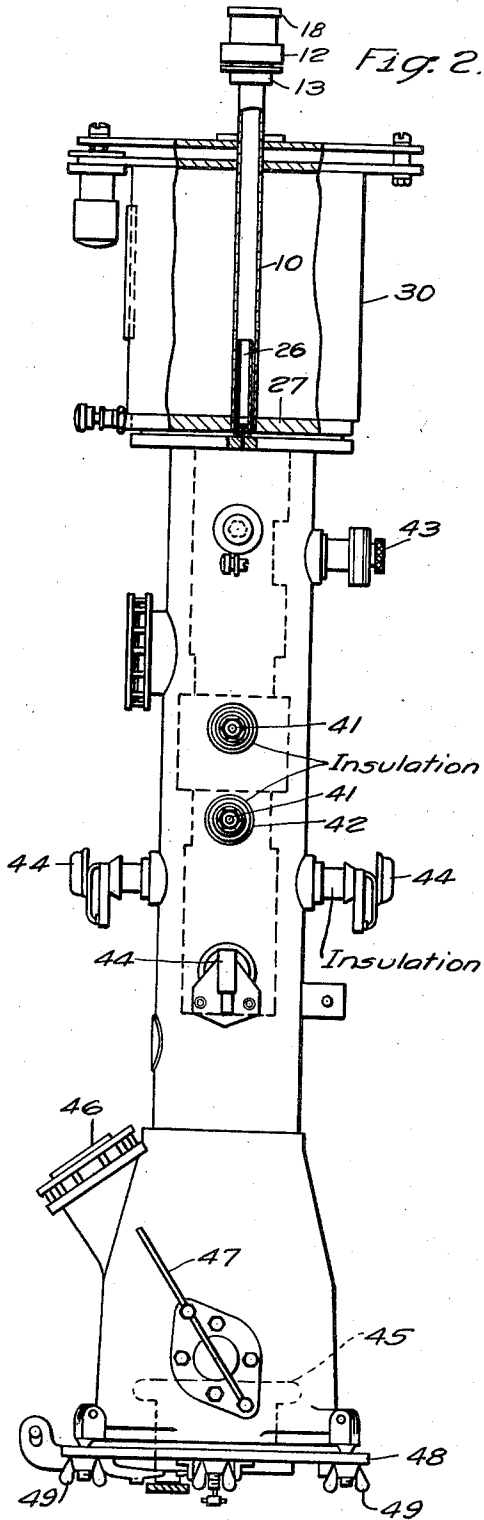
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F. R. BENEDICT

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CATHODE RAY TUBE

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INVENTOR
Frank R. Benedict.
 BY
F. W. Lyle
 ATTORNEY

UNITED STATES PATENT OFFICE

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CATHODE RAY TUBE

Frank R. Benedict, Pittsburgh, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, East Pittsburgh, Pa., a corporation of
Pennsylvania

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My invention relates to cathode-ray tubes, and especially to the cathode assembly thereof.

An object of my invention is to provide an intense and well concentrated cathode beam for the recording of high speed phenomena.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the drawing, in which:

Figure 1 is a view in cross-section of the main anode-cathode assembly of a cathode-ray tube disclosing my invention;

Fig. 2 is a view mainly in elevation and partly in cross-section of a preferred type of cathode-ray tube in which my invention is embodied; and

Fig. 3 is a graph disclosing the potential gradient between the cathode and anode of a cathode ray tube.

For the recording of very high speed phenomena with the cathode-ray oscillograph, it is important that an intense and well concentrated cathode beam be obtained. In the prior art, the problem of the concentration of a beam has been considered as a problem of anode structure and various modifications of the anode structure have been devised to concentrate the beam. My invention, on the other hand, contemplates designing the cathode structure so that the equipotential lines of force adjacent the active surface of the cathode will be convex toward this cathode surface, with the result that the particles emitted from the surface will be initially concentrated due to the lens-like action of these concave electric lines of force.

In Figure 1, I have disclosed a tube preferably of glass or quartz, having the cathode structure 11 extending therein preferably through a cap 12. This cap 12 is secured to a ring 13 surrounding the glass tube 10, and the cap 12 and ring 13 are attached to one another, preferably by a screw-threaded joint 14 that comprises suitable sealing material, such as rubber washers 15, to protect the desired vacuum inside the glass tube 10 from the atmosphere.

The cathode assembly comprises a central metal member, such as the rod 16, having an active face 17 and a shaft extending through the cap 12 to an outer cap 18. The cap 18 is secured to the shaft of the rod 16 and also has a screw-threaded connection 19 with the cap 12 for adjusting the position of the active face 17 within the glass tube 10. Bellows 20 surround the shaft of the rod 16 between the cap 12 and the cap 18. The rod 16 is of metal having a low work function that will provide the particles for the cathode ray beam from the active face 17. The

material of this rod 16 is preferably of aluminum or aluminum magnesium alloys or other suitable materials having a low work function.

Surrounding the rod 16 within the glass tube 10 is a cylinder 21 of a metal having a higher work function than that of the rod 16. This material is preferably that of stainless steel, although other materials with a high work constant function could be used, such as nickel, brass, copper, platinum, silver, gold, etc. This cylindrical member 21 may be attached to the inner part of the cap 12 by a screw-threaded joint as disclosed at 22.

The cylinder 21 has a rounded lip or edge 23 that extends beyond the active face 17 of the rod 16. In between the lip 23 and the active face 17 of the rod 16, the material is removed as shown at 24. I have disclosed this space 24 as being countersunk with the rod 16 projecting there-through. If desired, the shape of the face of the perforated cylinder 21 may be concave with the face 17 of the rod 16 above the central portion of the concave face. The active face 17 may be concave also although preferably to a slight extent.

Adjusting nuts 25 are disclosed for centering the glass tube 10 about the cathode structure. At the lower part of Fig. 2 is disclosed the metal tube 26 attached to the main anode 27 having a small perforated opening at 28 that becomes slightly larger at 29 for the emergence of the cathode beam.

In Fig. 2 is illustrated the type of cathode-ray tube to which my invention particularly applies. The members previously described in connection with Fig. 1 are disclosed in the upper part of Fig. 2, together with a casing 30 surrounding the major portion of the tube 10. Various connections, such as 41, may be made through insulation 42 to magnetic coils or to auxiliary electrodes within the casing. Screws 43 may be connected through the casing for the adjustment of other auxiliary electrodes. Connections 44 preferably extend through insulating bushings in the casing to electrostatic deflecting plates. The observation screen is a fluorescent plate 45 shown in dotted lines, viewed from a window 46. A film may be exposed by operating a shutter mechanism 47. The lower end of the device is closed by a plate 48 by means of bolts 49.

In Fig. 3, I have disclosed the potential gradient extending from the cathode structure to the main anode 27. It will be noted that nearly all of the major potential drop appears across the space adjacent the cathode, which is known as

the Crookes dark space. My invention contemplates utilizing this high potential gradient drop for controlling the beam direction by a suitable field shape of the cathode. I have already described my preferred cathode structure in which the active face 17 of the rod 16 is withdrawn in a plane away from the plane of the edge 23 of the cylinder 21 surrounding the rod 16 but is above the central portion of the cylinder 21. The result of this withdrawal is a concave shape to the equi-potential lens in the space adjacent the cathode face. This concave formation of the lines of force is illustrated at 50 and 51 by dotted lines. The particles forming the cathode-ray beam will be emitted from the active face 17, and these concave equi-potential lines of force will act like a lens to concentrate the beam on a line of the axis of the rod 16, as shown by the dotted lines 52. The result of this concentration will be to impinge the beam within the hole 28 instead of spreading it out over the surface of the anode 27, and then concentrating a portion of it through the opening 29 as in the prior art.

As illustrative and not limiting, I prefer to utilize the glass tube 10 with about one inch inside diameter and about 15 inches long. The rod 16 is about $\frac{1}{4}$ inch in diameter and the cylindrical member 21 is preferably $\frac{5}{8}$ inch in diameter with the lips 23 having rounded edges of about $\frac{1}{16}$ inch in thickness. The active face 17 of the cathode is preferably about 70 mils back of the plane of the rounded ends 23. The adjustment of the cap 18 is particularly valuable with the wear of the face 17 after the oscillograph

has been used for some time. The adjustment will bring the active face to the best operating position.

It is apparent that many modifications may be made in the shape, number and arrangement of the various elements. It is apparent, for example, that the rod 16 may be of shorter length and that a rod of other material may extend through the casing. Furthermore, the rod 16 may be fixed in position instead of being adjustable. Accordingly, I desire only such limitations to be imposed on the following claims as are necessitated by the prior art.

I claim as my invention:

1. A cathode for a cathode-ray tube in which a concentrated cathode-ray beam is produced and then subjected to deflection, said cathode comprising a central rod of aluminum and a cylinder of metal of higher work function surrounding said rod of aluminum, the rim of said cylinder projecting beyond the face of said rod.

2. A cathode for a cathode-ray tube comprising a central rod of aluminum and a cylinder of metal of higher work function surrounding said rod of aluminum, the rim of said cylinder projecting beyond the face of said rod, said rod extending above the portion of the cylinder immediately surrounding the rod.

3. A cathode for a cathode ray tube comprising a central rod of aluminum and a surrounding cylinder of steel, said cylinder having an edge projecting beyond the face of said aluminum rod.

FRANK R. BENEDICT.