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W. HEIMANN

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CATHODE RAY TUBE

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Fig. 1.

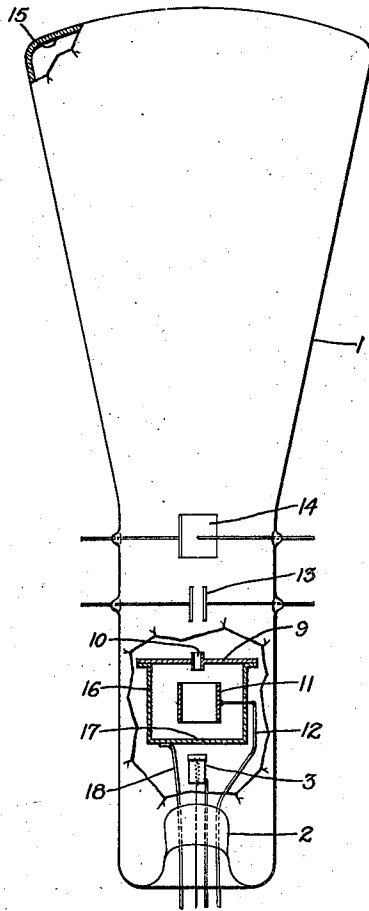
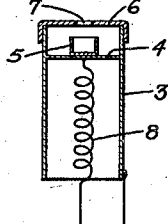


Fig. 2.



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UNITED STATES PATENT OFFICE

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CATHODE-RAY TUBE

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3 Claims. (Cl. 250—27.5)

The present invention relates to cathode-ray tubes provided with an electrostatic control member and used in the investigation of electric or magnetic phenomena.

In tubes of this sort, the electrons emitted by the cathode and accelerated by the anode are caused to be focused on a fluorescent screen by means of an electrostatic member which is sometimes known as a "Wehnelt cylinder". In order to increase the concentration of the electrons, there may be provided an inert gas within the envelope, as is well known. The cathode rays are usually deflected across the screen by means of a pair or pairs of plates to which the voltage under investigation is applied.

It has been found that when the voltage applied to the deflecting plates is less than about 100,000 cycles per second, the combined effect of the focusing member and the gas is usually sufficient to produce a sharp and well-defined light spot on the screen. However, at the higher frequencies, i. e. above 100,000 cycles per second, the light image becomes fuzzy with an indefinite outline. In order to improve the light character of the spot at these higher frequencies, the use of a gas of very low atomic weight has been proposed, for example hydrogen, which tends to constrain the electrons to a beam of uniform density in cross section. Notwithstanding the improvement in the focusing effect obtained by the use of such a gas, it has still been found that the light spot does not present a clearly defined image when the cathode-ray beam is deflected at frequencies above the order of 100,000 cycles per second.

An object of the present invention is to improve the light image when the tube is used under high frequency conditions. It has been found that the indefinite character of the light image is due in a large degree to the deleterious electrostatic effects produced on the control member and having their origin in the deflecting plates. In accordance with my invention, I propose to electrostatically shield the focusing member from these effects and for this purpose, provide a metal enclosure which completely surrounds the member. The invention will be more fully understood when reference is made to the following specification and accompanying drawing in which Fig. 1 represents an elevational view, partly broken away and in section, of a cathode-ray tube improved in accordance with my invention. Fig. 2 is an enlarged view, in cross section, of an exemplary form of cathode which may be used in the tube.

Referring to Fig. 1, numeral 1 designates the envelope of a cathode-ray tube which is provided with the usual flared-out portion terminated by a spherical glass wall. The spherical end of the envelope is coated on the interior with a well-known substance which fluoresces when struck by electrons. The other end of the envelope terminates in a reentrant stem 2 which supports the entire electrode structure except the deflecting plates. The cathode, as shown more clearly in Fig. 2, is constituted of a metal cylinder 3 provided at the upper end (as shown) with a transversely extending metal plate 4 carrying a metal cup member 5. The interior of the cup may be coated with an electronically active material. At the extreme upper end of the cylinder there is a metal cap 6 provided at the center with an electric discharge opening 7. Within the cylinder 3, there is a helical form of heater 8 secured at the upper end to the transverse disk 4. Leading-in conductors which also serve the purpose of supporting the cathode structure, are taken respectively from the lower end of the heater and from the cylinder 3, through the stem 2 to the exterior.

The anode may take the form of a metal plate 9 having a central discharge opening 10. In order to focus or otherwise control the electrons passing between the cathode 3 and the anode 9, there may be provided a cylindrical focusing member 11, mounted in line with the openings 7 and 10, as shown. The member 11 conveniently may be supported from the stem 2 by means of a rigid leading-in conductor 12.

In addition to this electrode structure, the envelope 1 also contains two pairs of deflecting plates 13, 14, rigidly mounted in the envelope by means of stiff wires which extend transversely across the envelope. The respective pairs of plates are arranged in different transverse planes with respect to the envelope and with respect to one another.

The envelope may contain an inert gas such as argon at a relatively low pressure.

When a tube of this sort is operated under conditions of high frequency, i. e. when high frequency voltage undulations are applied to the deflection plates 13, 14, it has been found that notwithstanding the presence of a gas within the tube and the focusing cylinder 11 charged to a proper potential for focusing, the light spot on the fluorescent screen 15 becomes blurred or fuzzy.

In order to reduce this effect, and in accordance with my invention, I provide an elec-

trostatic shield 16 about the focusing member 11. This shield conveniently may take the form of a metal cylinder secured directly to the anode, hence maintained at anode potential, and the bottom of which is completely closed except for a small discharge opening 17 in line with the opening in the cathode. The electrostatic control member 11 is thus surrounded on all sides by the metal member except for a discharge opening at the top and the bottom of the member through which electrons pass on their way to the screen.

It is evident that while I have shown the member 16 as being made of solid metal, this member may take the form of a metal cage or mesh enclosure, since its function is solely that of providing a positive field about the member 11 which serves to shield the member from the high frequency oscillations applied to the deflecting plates 13, 14. It is also apparent that the positive field as exerted by the metal enclosure 16 incidentally functions to accelerate the electrons between the cathode 3 and the control member 11. The enclosure 16 can conveniently serve as a support for the anode 9 and for this purpose, there may be provided a rigid leading-in conductor 18 sealed in the re-entrant stem 2 and secured to the bottom member of the enclosure.

While I have shown the metal enclosure 16 as being secured directly to the anode, hence maintained at anode potential, it is evident that the enclosure may be mounted separate from the anode and charged to any suitable positive potential.

It has been found in accordance with my invention, that when the focusing member 11 is completely surrounded by a positively charged metal member, the electric fields produced at the deflecting plates 13, 14 have substantially no effect on the action of the focusing member and hence, the latter is free to exercise its focusing or other controlling effect on the electron stream

as it passes through the anode and between the deflecting plates on its way to the fluorescent screen. By the use of the improved shielding member 16, the light spot on the screen is sharply defined, even when the electron beam is deflected at a rapid rate by voltages having frequencies, as high as 200,000 cycles per second or over, applied to the plates 13, 14.

While I have described my invention in connection with a cathode-ray tube of the gaseous type, it is to be understood that the positively charged shield 16 also offers an advantage by way of increasing the electrostatic controlling effect of the member 11 in a highly evacuated tube containing no gas.

What I claim as new and desire to secure by Letters Patent in the United States is:

1. A cathode-ray tube comprising an envelope containing a cathode, an electrostatic control member and electron-deflecting plates, and means for electrostatically screening said control member from the deflecting plates, said means including a cylinder completely enclosing said member except for discharge openings and adapted to be maintained at a positive potential with respect to the cathode.

2. A cathode-ray tube comprising an envelope containing inert gas, a cathode, an electron-focusing member and electron-deflecting plates, and means for electrostatically screening the focusing member from the deflecting plates, said means including a cylinder adapted to be maintained at a positive potential with respect to the cathode and completely enclosing solely the electron-focusing member except for discharge openings.

3. A cathode-ray tube comprising an envelope containing gas, a cathode, an anode, an electron-focusing member and electron-deflecting plates, said anode comprising a cylinder completely closed by a metal wall except for discharge openings and enclosing the focusing member.

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