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BRAUN TUBE FOR OSCILLOGRAPHIC AND TELEVISION PURPOSES

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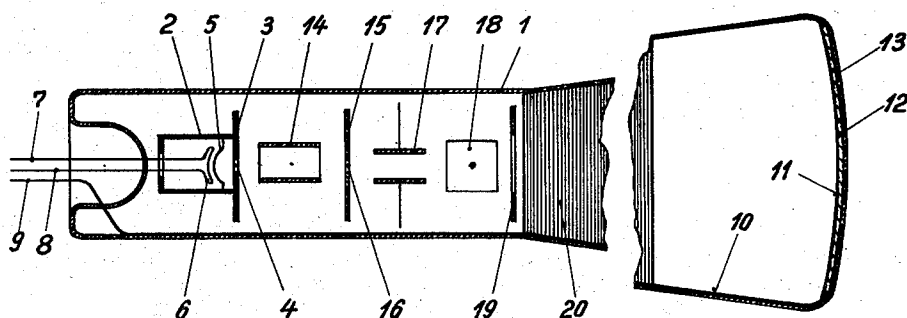


Fig. 1.

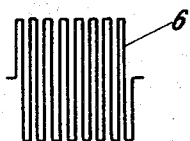


Fig. 2.

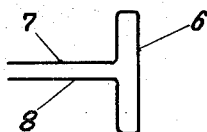


Fig. 3.

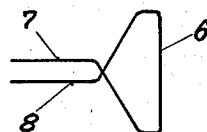


Fig. 4.

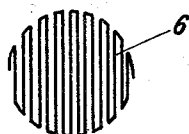


Fig. 5.

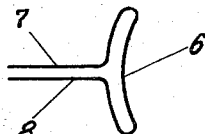


Fig. 6.

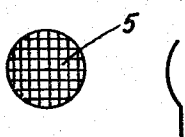


Fig. 8.

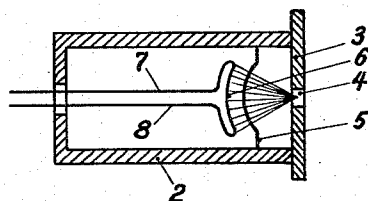


Fig. 7.

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UNITED STATES PATENT OFFICE

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BRAUN TUBE FOR OSCILLOGRAPHIC AND
TELEVISION PURPOSES

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17 Claims. (Cl. 250—27.5)

Having ascertained that it is possible with the assistance of a cylinder and an attraction anode to obtain sharp cathode ray images of a desired point (for example of the cathode surface or a shutter aperture). When the cylinder possesses, as compared with the cathode ray, a suitable negative, and the attraction anode, as compared with the ray, a suitable positive, relatively high potential, the system comprising the cylinder and attraction anode acts in the same manner as an optical lens. The cylinder and anode system will be referred to in the following simply as electron-optical system.

As set forth in the above, it is possible with the assistance of an electron-optical system of this nature to reproduce a shutter aperture in sharp form on the image screen of the tube. The aperture in this case behaves in the manner of a self-luminous surface. The intensity of the image screen reproduction is, therefore, dependent on the electronic intensity of this shutter aperture.

It was assumed that the cathode for a system of this nature should preferably be constructed as far as possible in spot-like form. It has been found, however, that the pointed cathodes employed for this purpose are incapable of supplying electrons in the requisite number.

According to the invention there is employed as cathode a large-surface cathode, and the bundle of electrons emitted is preliminarily concentrated, by the use of an electro-static lens, on to the shutter aperture, which is arranged preferably in the focal point of the lens. The electro-static lens consists, according to the invention, of the suitably formed cathode having, for example, a spherical surface, and a similarly formed auxiliary electrode, which is arranged at a slight distance from the cathode and is raised to a suitable potential as compared with the cathode. This auxiliary electrode may conveniently be produced from a wire netting having meshes of suitable size and number.

According to the invention, the cathode having the electrode in series therewith is arranged in a metallic cylinder, which is closed at the rear, and the front wall of which is constituted by the shutter. The concentration (control) electrode is preferably placed in conductive connection with the wall of the cylinder, so that between this electrode and the shutter a space is formed which is without field.

If it is desired to employ the tube as oscillograph tube (image points of constant intensity), the concentration electrode, as compared with

the cathode, is furnished with a suitable positive bias. This bias must be of sufficient extent to prevent as completely as possible the formation of a space charge, and on the other hand requires to be situated below the ionization potential of the particular gas employed as filling. With a spacing of approximately 1 mm. between the cathode and the concentration grid a potential of 10–15 volts has been found to be fully sufficient. Generally speaking, the potential of this electrode may preferably be so chosen that the same approximately corresponds with the natural potential (which is derived from the drop in potential: anode-cathode). By suitable selection of the spacing between cathode and concentration electrode it is quite readily possible to fulfil simultaneously the three conditions arising from space charge, ionization potential and natural run of potential. By this selection of the potential it is accomplished that the emission of the cathode is utilized to full extent, and that on the other hand the occurrence of the so-called drumming effect—as a result of which the life of the cathode is considerably diminished and which is based on the existence of ions—is safely avoided. In this manner it is possible to increase considerably the effectiveness and the life of the cathode.

If on the other hand it is desired to employ the tube as television tube (varying intensity of the image point), the control potential is applied between the cathode and the concentration electrode. In this case the control potentials may conveniently be adjusted in such fashion that in the case of the potential corresponding with the maximum intensity the space charge is completely eliminated, and that in the case of shadow potential the space charge is of such extent that no electrons, or practically no electrons, pass through the aperture in the shutter. With this control of the space charge it is possible to vary the intensity of the image point—with constant form and size thereof—from maximum intensity down to absolute darkness.

According to the invention, it is particularly convenient to construct the large-surface cathode in meandri-form. The heating current leads are bent off towards the rear, and are passed out as far as possible symmetrically. By reason of the bifilar guiding of the cathode wire and the symmetrical arrangement of the leads, it is possible to reduce the action of the heating current field to a minimum. By winding on to a calotte it is possible without difficulty to produce the meandri-form cathode according to the inven-

tion in the form of a spherical surface. Naturally, however, the cathode may also be constructed in the form of a simple or double spiral, conical spiral, flat spiral or the like. According to the invention, oxide cathodes may be employed. It is, however, also possible to employ metallic vapour high emission cathodes. For this purpose the meandri-form or spiral cathode is preferably made of oxidized tungsten wire, and a light-metal vapour, for example barium vapour, applied by atomization in the manner known per se to the finally wound and possibly also mounted cathode. In accordance with the invention, the light metal may be arranged within the cathode cylinder, and atomized, for example, by eddy current heating. In the same manner it is also possible to tension the light metal in the form of a thin wire between the current leads, and to atomize the same on to the cathode surface from the rear.

The use of indirectly heated cathodes is also possible in itself, but is not so convenient as that of the large-surface cathode according to the invention, as the filament power of indirectly heated cathodes is considerably greater. Nevertheless it is also possible for certain purposes to employ indirectly heated large-surface cathodes.

The high output of the tube according to the invention calls in the majority of cases for leakage at the image screen. For this purpose the image screen may be furnished in the manner known per se, either by a wet process or by cathodic atomization, with a thin metallic, for example silver coating. Coatings of this nature have heretofore always been shunted towards the outside. According to the invention, the leakage, in contradistinction thereto, is disposed on the inside of the tube. It is particularly convenient to construct this leak conductance in the form of a metallic deposit, which is arranged in strip form and may be produced, for example, by allowing a drop of metal solution or lacquer solution to run down the wall. Naturally, it is also possible to furnish the complete bulb of the tube down to the neck, either on the inside or on both sides, with a metallic screening and possibly also leak-conductive coating. The metallized surface of the luminous screen may be placed in conductive connection with the anode, or may act itself as after-acceleration anode.

The out-put supplied by the tube according to the invention is of such extent that in the case of slow movement of the ray the saturation limit of the luminous substance is reached or exceeded. In order now to prevent an excessive load on the luminous substance when the cathode ray moves slowly or is in a stationary condition, and at the same time to ensure maximum yield of light when the ray moves rapidly, the intensity of the ray, particularly in the case of oscillograph tubes, may be coupled with the rate of movement. This may be performed, for example, by varying the potential of the concentration electrode dependent on the variations in potential of the one or both pairs of deflecting plates, for example by the use of a double grid tube, in such fashion that a high rate of deflection corresponds with a correspondingly large positive bias of the concentration electrode, and a low rate of deflection with a correspondingly low potential of the same electrode.

Certain forms of embodiment of the arrangement according to the invention are illustrated by way of example in the drawing, in which

Fig. 1 is the diagram of the tube according to the invention,

Fig. 2 the view of a flat meandri-form cathode,

Fig. 3 the same cathode with the symmetrical-ly disposed leak conductances, viewed from the side,

In Fig. 4 there is shown the same cathode having a loop-like arrangement of the leak conductances,

Fig. 5 shows a meandri-form cathode with spherical surface form, viewed from the front, and Fig. 6 the same cathode with its leads, viewed from the side,

In Fig. 7 there is shown the cathode with the concentration electrode, the cathode cylinder and the shutter,

Fig. 8 shows the concentration and control electrode viewed from the front and from the side.

In the drawing 1 is the bulb, 2 the cathode cylinder, and 3 the shutter with the shutter aperture 4. The shutter aperture 4 possesses, in accordance with the invention, an extremely small diameter of approximately 0.1-1 mm. Since this aperture is projected exactly true to form by the electron-optical system 14, 15 on to the image screen, it may be accomplished by providing this aperture with a suitable form that the image point receives the most favourable form, for example the form of a triangle, rectangle, circle, square, rhombus or the like, for the composition of the image. Arranged in the cathode cylinder 2 and conductively connected therewith is the concentration electrode 5. The same possesses a similar spacial form to the cathode, and is preferably arranged at a very slight distance (for example, 1 mm.) from the same. Between the electrode 5 and the shutter plate 3 there is a space without field. The control potential (when using the tube as a television tube) is applied between the cylinder 2 and the cathode 6. 7 and 8 are the current leads for the cathode, 14 a cylinder, which possesses a low negative potential as compared with the ray, and 15 an anode, which possesses a relatively high positive potential as compared with the ray. 17 and 18 are the pairs of control plates, and 13 the image window with the luminous coating 12 and the metallic coating 11. 10 is the metallic lead to the coating 11, and 9 the current lead to this coating. 19 is an auxiliary electrode arranged between the last pair of deflecting plates and the fluorescent screen, 20 a concentrating electrode arranged on the inner side of the tube wall and projecting for 8-12 cm. into the tube. The concentrating electrode 20 has a potential lower than that of the auxiliary electrode. The potential difference may amount for instance to about 50-25° volts.

As shown by Fig. 7, the cathode and the concentration grid are arranged in such fashion that they form together a lens, in or near the focal point of which there is arranged the shutter aperture 4.

Naturally, various other forms of embodiment of the subject matter of the invention are also possible without departing from the spirit of the invention.

An essential feature of the invention is the provision of an electron-optical system, which reproduces a shutter aperture in sharp form on the image screen; the selection of the form and size of the shutter aperture to be reproduced in such fashion that the resulting image point possesses the most suitable form for the com-

position of the image; the use of a large-surface cathode and the preliminary concentration by means of a concentration electrode of suitable form, which is provided with a positive bias in relation to the cathode and forms together with the suitably shaped cathode an electron lens, in or near the focal point of which there is arranged the shutter aperture; the provision of the cathode in a cylinder which possesses the same potential as the concentration electrode; upon use as an oscillograph tube: selection of the bias for the concentration electrode in such fashion that the space charge is eliminated and the drumming effect avoided; in respect of a television tube: space charge control, whereby the control potentials are applied between concentration electrode and cathode, and are selected in such fashion that in the case of the control potential which corresponds with the maximum intensity the space charge is eliminated entirely but the ionization potential of the gas filling not reached, and in the case of the control potential corresponding with darkness the space charge is such that no or only very few electrons leave the shutter aperture; the construction and arrangement of the preferably double-wound and conveniently directly heated oxide or metallic vapour high emission cathode furnished with symmetrical leads. A further essential feature resides in the mounting, metallizing and leak conductance of the luminous screen, and in the control of the intensity dependent on the rate of deflection.

I claim:

1. A Braun tube comprising a large-surface cathode, an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being partially closed at its other end, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode on to said aperture, said concentrating means consisting of one concentrating electrode consisting of a wide mesh grid, said electrode being mounted between said cathode and said front wall of said cylinder and being adapted to be supplied with a bias.
2. A Braun tube comprising a cathode, a picture receiving screen, a plate furnished with a non-circular opening, the greatest width of which amounts to from 0.1 mm. to 1 mm., said plate being mounted between said cathode and said screen, an electron-optical system including an anode interposed between said plate and said screen for reproducing said non-circular opening on said screen, and deflecting means mounted between said electron-optical system and said screen for causing the cathode ray to scan said screen.
3. A Braun tube comprising a cathode, heating leads for said cathode, an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode, on to said aperture.
4. A Braun tube comprising a large surface cathode, heating leads for heating said cathode,

an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode on to said aperture.

5. A Braun tube comprising a large surface cathode, heating leads for said cathode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode on to said aperture, said concentrating means consisting of one concentrating electrode mounted between said cathode and said front wall of said cylinder and being adapted to be supplied with a bias.

6. A Braun tube comprising a large surface cathode, heating leads for said cathode, an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode on to said aperture, said concentrating means consisting of one concentrating electrode mounted between said cathode and said front wall of said cylinder and being electrically connected with said cylinder.

7. A Braun tube comprising a cathode, heating leads for said cathode, an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode on to said aperture, said concentrating means including an auxiliary electrode the spacial form of which is similar to that of said cathode, said auxiliary electrode being mounted near and parallel to said cathode.

8. A Braun tube comprising a cathode, heating leads for said cathode, an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode on to said aperture, said concentrating means including one auxiliary electrode, the spacial form of which is similar to that of said cathode, said auxiliary electrode being mounted near and parallel to said cathode, and being adapted to be

supplied with a bias and with a control voltage.

9. A Braun tube comprising a cathode, heating leads for said cathode, an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder to concentrate the electrons produced by said cathode onto said aperture, said concentrating means including an auxiliary electrode, the spacial form of which is similar to that of said cathode, said auxiliary electrode being mounted near and parallel to said cathode, and being adapted to be supplied with a bias which is high enough to avoid the formation of a space charge and low enough to prevent ionization inside said cylinder.

10. A Braun tube comprising a cathode having a spherical surface, heating leads for said cathode, an anode, a picture receiving screen, a cylinder surrounding said cathode, said cylinder being terminated at its end facing the anode by a plate having an aperture and being closed at its other end but for the opening necessary for taking said heating leads therethrough, the greatest extension of said aperture being small with respect to the diameter of said plate, and means inside said cylinder for concentrating the electrons produced by said cathode in to said aperture, said concentrating means including an auxiliary electrode, the spacial form of which is similar to that of said cathode, said electrode being mounted near and parallel to said cathode and being adapted to be supplied with a positive bias.

11. A Braun tube comprising means including a cathode and a plate shaped anode for producing a cathode ray, a picture receiving screen, a concentrating electrode mounted near said cathode between said cathode and said anode, said concentrating electrode having at its side facing said anode substantially the shape of a hollow spherical segment and being adapted to allow the passage of said cathode ray in a direction towards said image screen, and means mounted between said anode and said screen for deflecting said cathode ray to a temporarily varying degree.

12. A Braun tube comprising means including a large surface cathode and a plate shaped anode for producing a cathode ray, a picture receiving screen, a concentrating electrode mounted near said cathode between said cathode and said anode, said concentrating electrode having at its side facing said anode substantially the shape of a hollow spherical segment and being adapted to allow the passage of said cathode ray in the direction towards said image screen, and means mounted between said anode and said screen for deflecting said cathode ray to a temporarily varying degree.

13. A Braun tube comprising means including a large surface cathode and a plate-shaped anode for producing a cathode ray, a picture receiving screen, a concentrating electrode mounted near said cathode between said cathode and said anode, said concentrating electrode having at its side facing said anode substantially the shape of

a hollow spherical segment, and being adapted to allow the passage of said cathode ray in the direction towards said image screen, said concentrating electrode being further adapted to be supplied with a bias in relation to said cathode, and means mounted between said anode and said screen for deflecting said cathode ray to a temporarily varying degree.

14. A Braun tube comprising means including a large surface cathode and a plate shaped anode for producing a cathode ray, a picture receiving screen, a concentrating electrode mounted near said cathode between said cathode and said anode, said concentrating electrode having at its side facing said anode substantially the shape of a hollow spherical segment, said concentrating electrode being adapted to allow the passage of said cathode ray in the direction towards said image screen, said concentrating electrode being further adapted to be supplied with a positive bias in relation to said cathode, and means mounted between said anode and said screen for deflecting said cathode ray to a temporarily varying degree.

15. A Braun tube comprising means including a large surface cathode and a plate shaped anode for producing a cathode ray, a picture receiving screen, a concentrating electrode mounted near said cathode between said cathode and said anode, said concentrating electrode having at its side facing said anode substantially the shape of a hollow spherical segment, said concentrating electrode being adapted to allow the passage of said cathode in the direction towards said image screen, said concentrating electrode being further adapted to be supplied with a bias in relation to said cathode which is high enough to avoid the formation of a space charge and low enough to prevent ionization near said cathode, and means mounted between said anode and said screen for deflecting said cathode ray to a temporarily varying degree.

16. A Braun tube comprising means including a large surface cathode and a plate shaped anode for producing a cathode ray, a picture receiving screen, a concentrating electrode mounted near said cathode between said cathode and said anode, said concentrating electrode having at its side facing said anode substantially the shape of a hollow spherical segment and being adapted to allow the passage of said cathode ray in the direction towards said image screen, means for uniting the electrons forming said cathode ray into a sharp image point on said image screen, and means mounted between said anode and said screen for deflecting said cathode ray to a temporarily varying degree.

17. A Braun tube comprising means including a large surface cathode for producing a cathode ray, a picture receiving screen, an electron optical system including a plate-shaped anode for producing sharp electron images on said screen, a concentrating electrode mounted near said cathode between said cathode and said anode, said concentrating electrode having at its side facing said anode substantially the shape of a hollow spherical segment and being adapted to allow the passage of said cathode ray in the direction towards said image screen, and means mounted between said anode and said screen for deflecting said cathode ray to a temporarily varying degree.

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