

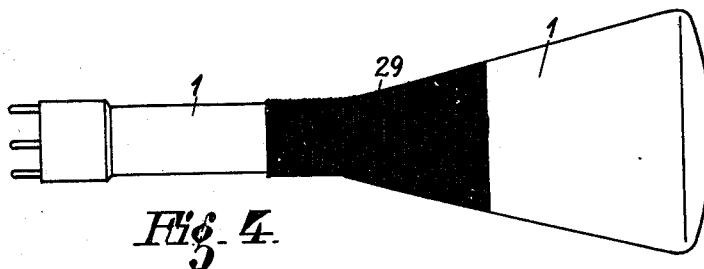
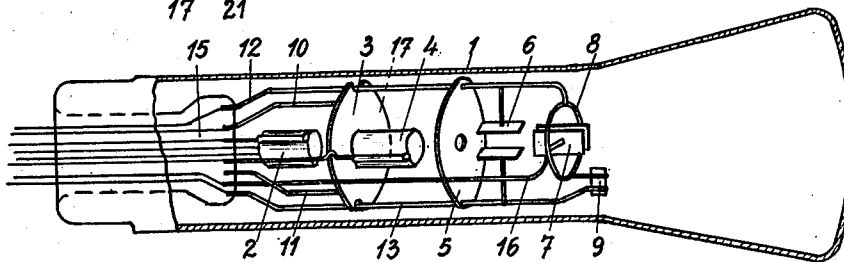
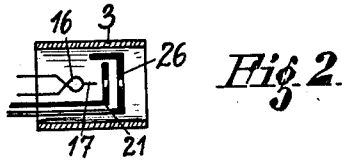
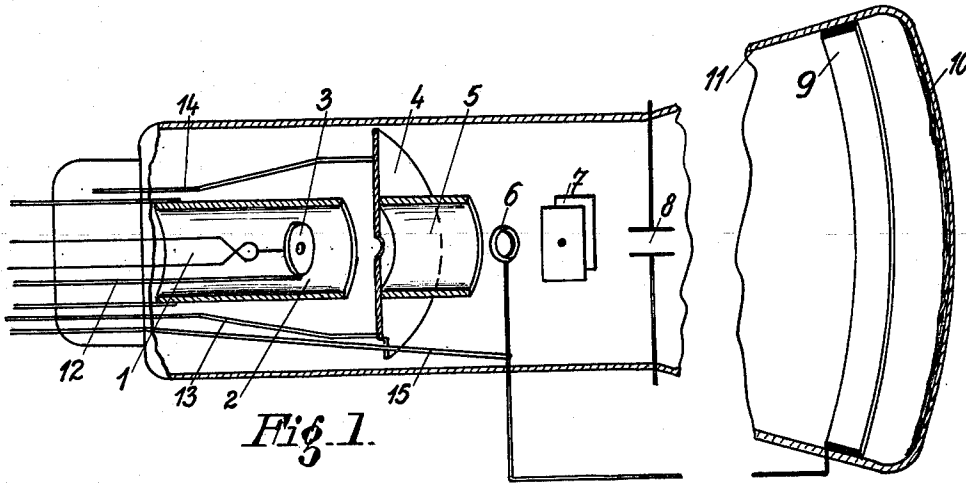
Aug. 4, 1936.

K. SCHLESINGER

2,049,781

BRAUN TUBE, ESPECIALLY FOR TELEVISION PURPOSES

Filed March 9, 1933



Inventor
Karl Schlesinger

UNITED STATES PATENT OFFICE

2,049,781

BRAUN TUBE ESPECIALLY FOR
TELEVISION PURPOSES

Kurt Schlesinger, Berlin, Germany, assignor to
Radioaktiengesellschaft D. S. Loewe, Berlin-
Steglitz, Germany, a company of Germany

Application March 9, 1933, Serial No. 660,117
In Germany March 10, 1932

12 Claims. (Cl. 250—27.5)

High vacuum cathode ray tubes with grid control are already known. Tubes of this kind, however, are not capable of being employed for television and recording purposes, as the point of light resulting on the image screen possesses, owing to insufficient concentration of the ray, a relatively large diameter and blurred contours. On the other hand in the case of the control grid arrangements hitherto known it is not possible to obtain satisfactory results in gas-filled tubes, as in these tubes there does not take place a pure electron discharge, but an ion discharge, and the ion discharge may be controlled only in very incomplete fashion with the assistance of grid arrangements.

A further disadvantage of the known Braun tubes consists of that a comparatively high control voltage of, say, 100 to 150 volts is necessary for obtaining a complete control of the cathode ray intensity, i. e., for modulating the cathode ray intensity from zero to the maximum possible intensity.

One object of the present invention is to provide a Braun tube wherein a gas-filling is of no influence upon the exactitude of the control of the intensity of the cathode ray.

A further object of the present invention is to provide a Braun tube wherein a complete control of the intensity of the cathode ray may be produced with comparatively low control voltages.

A still further object of the invention will be seen from the following description.

According to the present invention a Braun tube comprises a cathode, which may be preferably of the indirectly heated type, a Wehnelt cylinder surrounding said cathode, a control electrode arranged in front of said cathode at a distance of approximately one mm. from said cathode and insulated from said cathode by the vacuum, an apertured anode and a fluorescent screen.

Between the anode and the fluorescent screen deflecting means are arranged for deflecting the cathode ray in two directions perpendicular to one another for the purpose of scanning said screen.

Further, there may be provided an electron-optical system for the purpose of producing sharp image points, the shape and size of which are independent of the intensity of the cathode ray and do not substantially vary upon variations in the intensity of the cathode ray.

Different embodiments of the invention are described in the following. It will be clearly understood that these embodiments are given only by

way of example and that the invention is not restricted to these embodiments.

The control grid may preferably be arranged within the Wehnelt cylinder.

At a certain distance from the Wehnelt cylinder there is provided an anode. This, according to the invention, consists of a disc, the diameter of which is only to a very slight extent smaller than the diameter of the tube, and a cylindrical tube abutment arranged on this disc and having the same potential as the disc. This ante-anode receives a relatively low potential as compared with the cathode (for example, 250–400 volts).

By reason of the special form of the anode (large diameter) the spread otherwise occurring is avoided. The cylindrical abutment serves the purpose of accelerating all electrons to the same speed.

Behind the ante-anode there is provided an after-acceleration anode, which may also be constructed in the form of a shutter, and preferably possesses simply the form of a ring and receives a potential of 1500–4000 volts.

It has already been proposed to furnish the luminous coating itself with a thin metallic reflector on the rear, and to raise this reflector to a suitable potential. A metal coating of this nature, however, exerts a braking effect as regards the electrons impinging, and in consequence weakens the energy thereof and accordingly also the intensity of the light.

According to the invention, the luminous substance is not furnished with a metallic coating. On the other hand a metal ring is provided in the tube, which ring, for example, may consist of a thin layer of silver, and preferably is raised to the potential of the after-concentration anode. By reason of this measure the gas-braking effect on the ray otherwise occurring is avoided without a weakening of the intensity.

It has yet been found that the control of the intensity and the focusing in the case of this arrangement are still coupled together at a small degree in undesirable fashion. The brighter the ray, the larger is the diameter of the resulting image point. For television purposes this effect is an appreciable disadvantage. It has been found that the widening of the ray is occasioned in substance by the effect of the transverse and control fields of the grid electrode.

According to a further embodiment of the invention, therefore there is arranged in front of the control electrode a screening grid, possibly in the closest possible proximity thereto. This screening grid may conveniently be constructed

in the form of a cylinder open at the one end, which cylinder surrounds the control electrode, and possesses at the front an aperture corresponding with the opening in the control grid. By suitable selection of the potentials of the control electrode, the screening grid and the Wehnelt cylinder, and also by suitable shaping of the stated electrodes, it is possible to completely eliminate the effects of the control and transverse fields of the control electrode, and to obtain an exactly spot-like image in respect of each intensity of the ray.

The following potentials have been found to be suitable: Control-electrode potentials ~ 5 volts (alternating potential) screening grid: $+10$ — $+40$ volts; Wehnelt cylinder -50 — -150 volts. A potential of 30 volts has been found to be particularly suitable in respect of the cylindrical screening grid, if the Wehnelt cylinder is raised to a potential of -100 volts.

In detail, the optimum potentials are dependent to a very great extent on the form and also the spacing of the single electrodes. It is possible, however, without difficulty to determine these optimum potentials by comparative measurements with given form and arrangement of the electrodes.

According to a further object of the invention the tube is furnished with a metallic electrode arranged on its wall preferably on its inner side. Said electrode may be arranged near the screen of the Braun tube and consists of a thin metallic sediment preferably of silver, which may be connected to the anode of the tube, that is to the highest potential which is wanted therein.

According to another embodiment of the invention the sediment (metallic electrode) is arranged at the inner side of the tube near the middle of said tube as indicated in Fig. 4 in such manner that the electrode in each position of the cathode ray is far enough from said ray as to avoid an influence of said electrode to the position of the cathode ray. In this case the electrode may be supplied with a potential which is a little (e. g. 100–300 volts) lower than the highest potential which is employed in the tube.

The electrode arranged on the wall of the tube possesses a very effective concentrating effect to the cathode ray.

In the accompanying drawing

Fig. 1 shows diagrammatically an embodiment of a Braun tube according to the invention, the control element of which is arranged inside the Wehnelt cylinder.

Fig. 2 shows a further embodiment of the control arrangement.

Fig. 3 shows a Braun tube furnished with a special electron-optical system, which shall preferably be employed in combination with the control element according to the invention.

Fig. 4 is a view of a Braun tube according to the invention, which shows especially the form and the arrangement of the concentrating electrode.

In Fig. 1 11 is the tube having the cathode 1, the control grid 3 and the Wehnelt cylinder 2. The control grid is arranged in the dark space of the cathode. 4 is the ante-anode with the cylindrical abutment 5. The ante-anode is held on either side by the lines 13 and 14. The holding on both sides by live holders is necessary in order to protect the cathode ray against the electrostatic effect of the potential feed line 15. The after-acceleration anode 6 is connected with the metallic ring 9. 7 and 8 are the pairs of control plates, 10 is the luminous substance.

By reason of the ante-anode flash-over effects between the pointed cathode and the anode are avoided. Beyond this, when employing this anode, the lifetime of the cathode is increased to a multiple extent, as the impact of the ions is very greatly attenuated owing to the weakening of the electric field. The tube is preferably filled with argon or hydrogen at a pressure of approximately 10^{-3} mm. Naturally, there may be provided in the tube getter substances, which ensure constancy of the gas pressure. In the same manner it is naturally also possible to provide in the tube substances which possess a certain hydrogen dissociation pressure. When using substances of this nature (for example hydrides) an actual constancy of the hydrogen pressure may be accomplished, and the so-called hardening of the tube is safely prevented.

In Fig. 2 1 is the tube body, 2 the holder for the system, 3 the Wehnelt cylinder, 16 the electrode with the point 17, 21 the control grid constructed in the form of a perforated shutter, 26 the cylindrical screening grid surrounding the control grid on all sides.

Naturally, it is quite readily possible to select a different form, arrangement and potential in respect of the single electrodes. It is merely essential as regards the invention that in the vicinity of the control grid there is provided a screening grid, which possesses a relatively weak positive potential, preferably surrounds the control grid, and eliminates as completely as possible the effects of the control and transverse fields. It is possible in this manner at the point where the ray emerges—which may be regarded as apparent cathode—to adjust to a zero potential, and in this manner to prevent entirely any widening of the ray.

Fig. 3 shows the electron optical system which preferably shall be employed in combination with the control arrangement according to the invention.

In Fig. 3 15 is the stem of the valve, 2 the space-charge-control (the cathode itself is not visible), 3 the screening anode with a small screening aperture 17, 4 the after-concentration cylinder, 5 the after-acceleration anode, 6 and 7 the two pairs of control-plates, which may possess the same potential. It has been proved suitable to arrange the cylinder 4 as close as possible to the screening anode. It is also possible to reach the effect according to the invention in case the cylinder is arranged in about the middle between the ante- and the after-acceleration anode; in contradistinction to this it is unsuitable to arrange this cylinder close to the after-acceleration anode. 10, 11, 12, 13, 16 and 8 are parts of the whole system, 9 an isolation separator, for instance consisting of mica. Naturally shape, size and arrangement of the system as well as of the electrodes may doubtless differ from the subject of performance as illustrated by way of example in the drawing. Naturally the screening anode may be supplied on the side turned towards the after-concentration cylinder with a tube shaped metallic continuation.

It is also possible to give the anode a shape of a little casket. The image screen may suitably be furnished with a thin metallic layer, which nearly possesses the potential of the anode or suitably a higher potential than the after-acceleration anode. Instead of metallizing the image screen itself, on the walls of the tube near the image screen a metallic ring or a metallic

deposit possessing the above mentioned potential may be arranged.

The valve may suitably be used with a gas-filling in a manner known per se.

5 The magnitude of the potentials to be employed depends upon the distance of the image screen from the electron-optical system, as well as upon the shape, the size and the distance of the electrodes between each other. The electrode
10 system once fixed, makes it possible without difficulties to set at normal the several voltages, in order to adjust the focus in the plane of the image screen. Experiments with valves of the usual dimensioning indicated the potentials of
15 the electrodes to lie within the following limitations: the potential of the space charge controlling cylinder to about -100- -200 volts, screening anode +300- +400 volts; after-concentration cylinder +100- +250 volts; after-acceleration anode +2000- +4000 volts.

Special shaping, size dimensioning or arranging of the electrodes may make it necessary to deviate in not an unessential manner from the above mentioned values of voltages.

25 In Fig. 4 1 is the tube body, 29 the electrode which is preferably supplied with a potential, which is a little, for instance for 100-300 volts lower, than that of the after-concentration anode.

I claim:

30 1. A Braun tube comprising a cathode, a Wehnelt-cylinder surrounding said cathode, a control electrode mounted inside said Wehnelt-cylinder at a distance of approximately one mm. from said cathode, said electrode being adapted to be supplied with a bias and with a control voltage, an
35 anode and a fluorescent screen.

2. A Braun tube comprising a cathode, a Wehnelt-cylinder surrounding said cathode, a control electrode mounted inside said Wehnelt-cylinder
40 at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a bias and with a control voltage, a screening electrode of cylindrical form surrounding said control electrode, said screening
45 electrode being adapted to be supplied with a weak positive bias up to forty volts, an anode and a fluorescent screen.

3. A Braun tube comprising a glow-cathode, a Wehnelt-cylinder surrounding said cathode, said
50 Wehnelt-cylinder being adapted to be supplied with a negative bias, a control electrode mounted inside said Wehnelt-cylinder at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with
55 a control voltage, an anode consisting of a perforated shutter, the diameter of which is little smaller than the diameter of the neck of the Braun tube, said shutter being furnished with a cylindrical abutment, and a fluorescent screen.

60 4. A Braun tube comprising a glow-cathode, a Wehnelt-cylinder surrounding said cathode, said Wehnelt-cylinder being adapted to be supplied with a negative bias, a control electrode mounted in front of said cathode at a distance of approximately 1 mm. from said cathode, said control
65 electrode being adapted to be supplied with a control voltage, an apertured plate furnished with a cylindrical abutment, the diameter of said abutment being considerably greater than the diameter of the plate aperture, said plate being adapted
70 to be supplied with a low positive voltage, a further apertured anode plate adapted to be supplied with a high positive voltage, and a fluorescent screen.

75 5. A Braun tube comprising a glow-cathode, a

Wehnelt-cylinder surrounding said cathode, said Wehnelt-cylinder being adapted to be supplied with a negative bias, a control electrode mounted in front of said cathode at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an anode plate adapted to be supplied with a low positive voltage, a concentrating cylinder adapted to be supplied with a voltage which is more negative than that which the
15 said anode is to be supplied with, a further anode plate adapted to be supplied with a high positive voltage, and a fluorescent screen.

6. A Braun tube comprising a glow-cathode, a Wehnelt-cylinder surrounding said cathode, said
20 Wehnelt-cylinder being adapted to be supplied with a negative bias, a control electrode mounted inside said Wehnelt-cylinder at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an anode plate adapted to be supplied with a low positive voltage, a concentrating cylinder adapted to be supplied with a voltage which is more negative than that which the said anode is to be supplied with, a further
25 anode plate adapted to be supplied with a high-positive voltage, a fluorescent screen, an electrode mounted near said fluorescent screen, said electrode being connected with said further anode.

7. A Braun tube containing a cathode, a control
30 electrode mounted near said cathode at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an anode plate adapted to be supplied with a high positive voltage, a fluorescent screen, and an auxiliary electrode of cylindrical shape mounted between said
35 anode plate and said fluorescent screen near said anode plate, said auxiliary electrode being adapted to be supplied with a voltage which is a little lower than the high anode voltage.

8. A Braun tube containing a cathode, a control electrode mounted near said cathode at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an anode plate adapted to be supplied with a high positive voltage, a fluorescent screen, and an auxiliary electrode consisting of a metallic wall coating mounted between said anode plate and said fluorescent
50 screen near said anode plate, said auxiliary electrode being adapted to be supplied with a voltage which is more negative than the high anode voltage.

9. A Braun tube comprising a glow-cathode, a
55 Wehnelt-cylinder surrounding said cathode, said Wehnelt-cylinder being adapted to be supplied with a negative bias, a control electrode mounted inside said Wehnelt-cylinder at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an anode plate adapted to be supplied with a low positive voltage, a further anode plate adapted to be supplied with a high positive voltage, a fluorescent screen, and an auxiliary electrode consisting of a metallic wall coating, the length of said coating amounting to from eight to ten cm. mounted between said anode and said fluorescent screen near said anode, said auxiliary electrode being adapted to be supplied with
70 a voltage which is more negative than the high anode voltage.

10. A Braun tube comprising a glow-cathode, a Wehnelt-cylinder surrounding said cathode, said Wehnelt-cylinder being adapted to be supplied 75

with a negative bias, a control electrode mounted inside said Wehnelt-cylinder at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an anode plate adapted to be supplied with a low positive voltage, a concentrating cylinder adapted to be supplied with a voltage which is more negative than that which the said anode is to be supplied with, a further anode plate adapted to be supplied with a high positive voltage, a fluorescent screen, and an auxiliary electrode consisting of a metallic wall coating, the length of said coating amounting to from eight to ten cm. mounted between said anode and said fluorescent screen near said anode plate, said auxiliary electrode being adapted to be supplied with a voltage which is more negative than the high anode voltage.

11. A Braun tube comprising a glow-cathode, a Wehnelt-cylinder surrounding said cathode, said Wehnelt-cylinder being adapted to be supplied with a negative bias, a control electrode mounted inside said Wehnelt-cylinder at a distance of approximately 1 mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an anode plate adapted to be supplied with a low positive voltage, a concentrating cylinder adapted to be supplied with a voltage which is more negative than that which the said anode is to be supplied with, a further anode plate adapted to be supplied with

a high positive voltage, a fluorescent screen, an electrode arranged near said fluorescent screen, said electrode being connected with said further anode, and an auxiliary electrode consisting of a metallic wall coating, the length of said coating amounting to from eight to ten cm. mounted between said further anode and said fluorescent screen near said further anode, said auxiliary electrode being adapted to be supplied with a voltage which is more negative than the high anode voltage.

12. A Braun tube comprising an indirectly heated cathode, a Wehnelt cylinder surrounding said cathode, a control electrode consisting of an apertured plate mounted in front of said cathode at a distance of approximately one mm. from said cathode, said control electrode being adapted to be supplied with a control voltage, an apertured anode mounted in front of said control electrode, a fluorescent screen, an electron-optical system arranged between said apertured anode and said fluorescent screen, said electron-optical system producing a sharp image of the aperture of said apertured anode on said fluorescent screen, and two pairs of deflecting plates mounted between said electron-optical system and said fluorescent screen for deflecting the cathode ray in two directions perpendicular to one another for scanning said screen.

KURT SCHLESINGER.