Nov. 30, 1937. M. VON ARDENNE 2,100,704

TELEVISION RECEPTION ARRANGEMENT WITH BRAUN TUBES

Filed Dec. 23, 1931 2 Sheets-Sheet 1

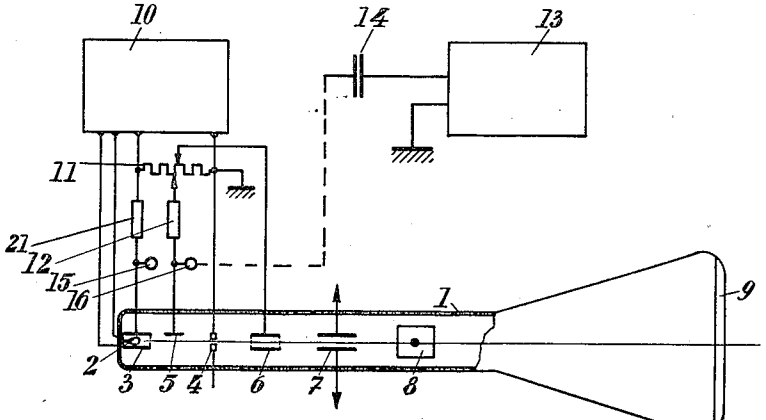

Fig. 1

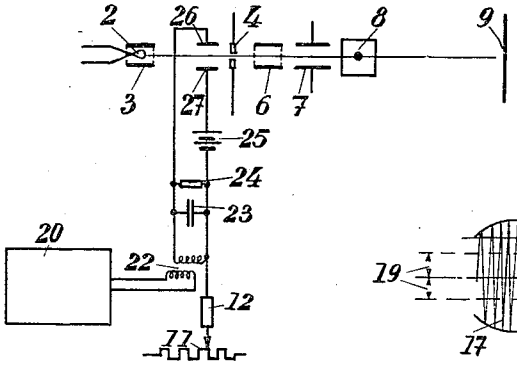

Fig. 4

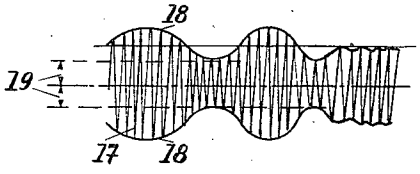

Fig. 2

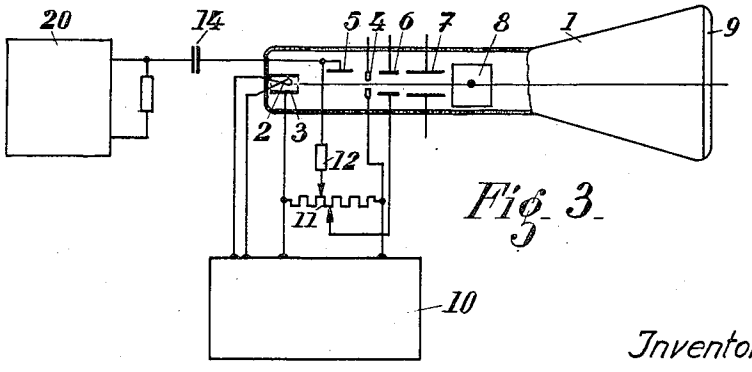

Fig. 3

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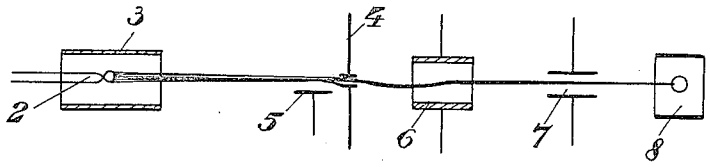

Fig. 5.

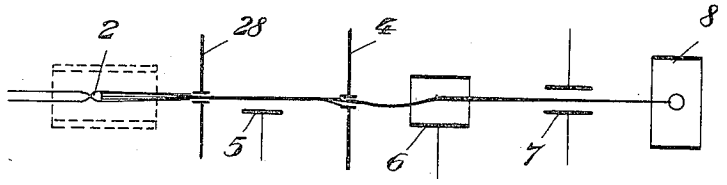

Fig. 6.

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Patented Nov. 30, 1937

2,100,704

UNITED STATES PATENT OFFICE

2,100,704

TELEVISION RECEPTION ARRANGEMENT WITH BRAUN TUBES

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Application December 23, 1931, Serial No. 582,740
In Germany December 23, 1930

20 Claims. (Cl. 178—7.5)

In the case of receiving apparatus for television purposes heretofore known employing a Braun tube as receiving element there has been found the drawback that the cathode ray controlled in front of the anode is effected in its direction by the intensity control.

The present invention deals with elimination of the influence of this deflection. To accomplish this the cathode ray passing through the anode is again centralized in the tube axis by a concentric cylinder.

Fig. 1 shows a preferred embodiment of the invention.

Fig. 2 illustrates the rectifying action of my invention when connected as in Fig. 3.

Fig. 3 shows a modification of my invention.

Fig. 4 shows a further modification.

Figs. 5 and 6 illustrate alternative arrangements of the elements of a cathode ray tube.

The arrangement according to the invention is illustrated in a possible form of embodiment in Fig. 1. In the latter 1 is the Braun tube having the hot cathode 2, the Wehnelt cylinder 3 and the anode 4. The anode 4 is furnished with a slit of approximately 1 millimetre in width and 2–3 millimetres in length, or possibly also with a small tube, by means of which the cathode ray is shuttered. To the side of the central point, between the Wehnelt cylinder and the anode, there is the deflecting plate 5, and behind the anode the centralizing cylinder 6 and the pairs of deflecting plates 7 and 8, while 9 represents the fluorescent screen. In Fig. 1, 10 is a main line connection apparatus, which supplies the cathode 2 with the necessary heating potential of, for example, 1 volt, the Wehnelt cylinder 3, for example through the medium of a resistance 21, with a negative bias of, say, —300 volts, and the anode 4 with a positive potential of, say, 3,000 volts against the cathode. The terminal for the positive end of the anode potential +3,000 volts is preferably taken to earth, and is connected through the medium of a potentiometer resistance 11 of, for example, 10 megohms with the terminal for the negative cylinder bias of —300 volts. By this potentiometer resistance there is tapped both an initial potential of, say, +1,600 volts, which is conducted to the deflecting plate 5 through the medium of a resistance 12, as well as a further initial potential of, say, +1,400 volts, which is applied to the centralizing cylinder 6. This potential must be so regulated that the electrons are not retarded by the cylinder, but are merely brought together on the cylinder axis, and on the other hand do not depart excessively from the said axis. The control of the intensity may be performed by connection of the light control amplifier 13 over a condenser 14, of, for example, 10^4 cm., which either controls at the terminal 15 the Wehnelt cylinder, or at the terminal 16 the deflecting plate. In the former case the deflecting plate 5 merely has the significance of preliminary centralization of the ray; the second method of control, however, offers considerably greater advantages. It is particularly desirable in a tube of this kind to make all of the metallic parts, with the exception of the one electrode, for example the anode, i. e., both the deflecting plate as well as the cylinder, of non-magnetic material, while the anode is preferably produced from magnetic material, such as nickel, in order to suitably set the ray by magnetic bias.

The adjustment of the Braun tube is, therefore, then performed preferably as follows: The anode is polarized by means of a magnet in such fashion that the irregularities of the Wehnelt cylinder are substantially compensated. The Wehnelt cylinder acts by reason of its initial potential in greatly concentrating fashion on the cathode ray, so that the latter is concentrated substantially to the slit in the anode. The deflecting plate 5 is now adjusted in such manner that the cathode ray meets against the upper or lower edge of the gap, dependent on the fact as to whether it is desired to produce a positive or negative image of the amplitude control. The cathode ray controlled in its intensity by this plate through the medium of the light control amplifier then passes the anode in a somewhat deflected direction, is again brought along the central path by the centralizing cylinder, and passes the two deflecting plate systems, of which there is impressed on the one the line frequency and on the other the image frequency.

Braun tubes of this nature, which are controlled in their intensity by a non-concentrically acting control element, are admirably suited for direct control by the high frequencies transmitting the intensity amplitude, whilst avoiding a particular rectifier, and also more particularly a special low frequency amplifier. If the cathode ray is adjusted in such fashion, more particularly by means of the control electrode 5, that exactly the smallest maximum amplitude of the transmitted oscillation conforming with the darkness or brightness respectively has no influence on the intensity, i. e., lifts the ray exactly up to the edge, an adjustment of this nature produces a rectifying effect, by means of which, with a sufficient high frequency output, the use of a recti-

fier with after-connected low frequency amplifier is rendered superfluous.

In Fig. 2 these conditions are illustrated diagrammatically. In this 17 is the high frequency oscillation, the peak amplitudes of which are represented by the bounding lines 18. 19 is the maximum modulation amplitude, which accordingly conforms to complete darkness or complete brightness. The cathode ray is so adjusted that the same meets against the upper or lower edge of the light gap exactly at this potential. Beyond this the connection of the Braun tube may be exactly the same, as disclosed by Fig. 3, in which the same designations have been employed as in Fig. 1. In this connection it is merely to be noted that the high frequency amplifier 20 controls the electrode 5 in immediate fashion over the condenser 14.

Naturally it is also possible to employ a pair of plates for control purposes, as illustrated in a possible form of embodiment in Fig. 4. In this figure the single elements of the Braun tube have been furnished with the same numerals. In place of the deflecting plate 5 there are a pair of deflecting plates 26 and 27, to which the control oscillations are conducted by a high frequency amplifier via the transformer 22, the secondary coil of which forms together with the condenser 23 an oscillatory circuit damped in regulable fashion by the resistance 24. The constant initial voltage is again conducted to the electrode 26 from the potentiometer 11 over the resistance 12, whereby it is certainly to be observed that in order to permit of deflection the constant initial potential of the electrode 27 requires to possess a different value, which may be produced by the inclusion of an auxiliary battery 25 in the line leading to this electrode.

Now it has been found that it is not possible to obtain a sufficiently sharp image point merely by suitable selection of the initial potentials of the Wehnelt cylinder, or the after-concentration cylinder respectively. In the first arrangement, in which the deflecting electrode, or pair of electrodes, are situated at no very considerable distance, say 5 mm., from the edge of the Wehnelt cylinder, it has not been possible to obtain an image point of sufficient sharpness. As shown by tests, the beam of light emerging from the cathode assumes by reason of the Wehnelt cylinder only at a certain distance from the latter a sharpness of such nature that lateral deflection caused by the deflecting electrodes controlling the intensity does not result in inadmissible dispersion of the beam.

According to the further subject of invention, the deflecting electrode, or pair of electrodes, controlling the intensity are disposed at such a distance away from the Wehnelt cylinder as may be required to ensure the necessary sharpness of the point.

In Fig. 5 there is illustrated a tube of this nature in a possible form of embodiment. In the same 2 is the cathode, 3 the Wehnelt cylinder, 5 the deflecting electrode controlling the intensity, 4 the anode, 6 the after-concentration cylinder, and 7 and 8 the deflecting plates bearing the image and line frequencies. It is to be observed that in particular the second pair of plates 8 are of such width that the edge effect of these electrodes has no disturbing influence on the image, i. e., does not result in distortion of the image. In the drawings there is indicated the path of the beam of light. Upon emerging from the cathode at the point *a* the same is relatively wide. This width decreases within the cylinder, but it is only opposite the plate 5 that the same assumes such a degree of fineness that the deflection does not result in a dispersion of such nature that it is not possible, by reason of the subsequent concentration cylinder 6, to impart to the image point the necessary degree of fineness on the screen.

An additional possibility of accomplishing the requisite degree of fineness of the beam consists in employing in place of the Wehnelt cylinder a plate-like electrode similar to the one acting as anode and also furnished with a fine aperture. When employing an electrode of this nature it is not essential to locate the deflecting electrode at any considerable distance, as in this case the concentration of the beam is much greater than when employing a Wehnelt cylinder.

An arrangement of this description is illustrated in a possible form of embodiment in Fig. 6. In the latter the cathode is in similar manner designated 2, the deflecting electrode 5, the anode 4, the after-concentration cylinder 6, and the deflecting pairs of plates 7 and 8. In place of the Wehnelt cylinder there is provided the plate 23, which preferably possesses the same potential as the cathode ray at the corresponding point. It is naturally also possible to employ a Wehnelt cylinder and a concentrating plate of this nature at the same time.

Experiments conducted by the applicant have shown that also in employing all above mentioned improvements certain distortions still occur, which for a long time were thought to be due to a tendency towards sluggishness at the transmission end. It has, however, been found that this sluggishness in point of fact exerts only a very small influence on the distortion, while the main reason for the distortions is to be found in a mutual influence exerted by the after-concentration electrode and the neighbouring pair of plates. To avoid this and at the same time to preclude any effect exerted by the two pairs of deflecting plates on each other the spacial disposal was increased, whereby it was readily possible to obtain an increase in the number of image points to more than twice the number. It is naturally also possible to avoid the relative disturbing influence of electrode systems in other ways, for example to screen the same off against each other. In the present case, however, since quite considerable improvements are obtained by increasing the spacing to only extremely slight extent, it is more simple to merely make the spacing of a sufficient amount. Generally speaking, it is naturally only necessary to screen off those particular control elements against each other, or to space the same sufficiently wide apart that they have no influence on each other, of which the one or both possess varying potentials, and in particular potential differences which relatively vary.

According now to the invention, those elements are spaced widely apart which are capable of exerting on each other a disturbing effect. These are more particularly the ones which possess a relatively varying potential difference and, as experiments have shown, chiefly the after-concentration cylinder 6 and the adjacent pair of deflecting plates 7. The spacing of these two elements was shown in the tests conducted by the applicant to have an influence of such extent on the quality of the image that with a spacing of approximately 9 millimetres under otherwise similar conditions image points

amounting in number to approximately 4,000, of 10 millimetres to approximately 6,000, and of 15 millimetres to approximately 10,000 were obtainable.

I claim:

1. In a television reception arrangement in combination a Braun tube comprising a cathode and a plate-shaped anode furnished with a small aperture arranged in operative relationship thereto, at least one deflecting electrode arranged between said cathode and said anode in operative relationship to said aperture of said anode, a picture receiving screen, deflecting means arranged between said picture receiving screen and said anode and means for maintaining constant the direction as well as the position of the path along which the cathode ray enters the space wherein it is deflected, said means being arranged between said anode and said deflecting means and including a cylindrically shaped concentrating electrode; means to supply said deflecting electrode with a bias and with a control voltage; means to supply said anode with a high positive potential in relation to said cathode; and means to supply said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

2. In a television reception arrangement in combination a Braun tube comprising a cathode and a plate-shaped anode consisting of a magnetic material furnished with a small aperture arranged in operative relationship thereto, at least one deflecting electrode arranged between said cathode and said anode in operative relationship to said aperture of said anode, a picture receiving screen, deflecting means arranged between said picture receiving screen and said anode and means for maintaining constant the direction as well as the position of the path along which the cathode ray enters the space wherein it is deflected, said means being arranged between said anode and said deflecting means and including a cylindrically shaped concentrating electrode, all of said electrodes but the anode consisting of non-magnetic material; means to supply said deflecting electrode with a bias and with a control voltage; means to supply said anode with a high positive potential in relation to said cathode; and means to supply said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

3. A Braun tube comprising a cathode, an anode arranged in operative relationship thereto, means for controlling the intensity of the cathode ray, a picture receiving screen, means for applying a positive potential to said anode, and at least one more concentrating electrode arranged between said anode and said screen, means for applying a potential to said electrode which is more negative than the potential of said anode, and two pairs of deflecting plates arranged between said electrode and said screen, the distance between said concentrating electrode and the first pair of deflecting plates arranged between said electrode and said screen being at least as great as the distance between the plates of said first pair of deflecting plates for the purpose of preventing a mutual influence of the electrostatical deflecting field upon the electrostatical concentrating field.

4. A television reception arrangement comprising in combination a Braun tube comprising an envelope enclosing a cathode and an anode mounted in operative relationship thereto, a control electrode for controlling the intensity of the cathode ray, said control electrode being mounted in the vicinity of said cathode, a picture receiving screen, means for deflecting the cathode ray in two directions perpendicular to one another for scanning said screen, said deflecting means being mounted between said anode and said screen, and concentrating means comprising a cylindrically shaped electrode mounted between said anode and said deflecting means; means for supplying said anode with a high positive bias with respect to said cathode and means for supplying said electrode with a potential which is lower than the potential of said anode but higher than that of said cathode.

5. A television arrangement comprising in combination a Braun tube comprising an envelope enclosing a cathode and an anode mounted in operative relationship thereto, a control electrode for controlling the intensity of the cathode ray, said control electrode being mounted in the vicinity of said cathode, a picture receiving screen, means for deflecting the cathode ray in two directions perpendicular to one another for scanning said screen, said deflecting means being mounted between said anode and said screen, and concentrating means comprising a cylindrically shaped electrode mounted between said anode and said deflecting means; means for supplying said anode with a high positive bias with respect to said cathode; and means for supplying said electrode with a potential which is for some hundred volts lower than that of said anode.

6. A television arrangement comprising in combination a Braun tube comprising an envelope enclosing a cathode, a picture receiving screen, a Wehnelt cylinder surrounding said cathode, an anode mounted between said cathode and said picture receiving screen, two pairs of deflecting plates mounted between said anode and said screen for deflecting the cathode ray in two directions perpendicular to one another for scanning said screen, and additional concentrating means mounted between said anode and said deflecting plates, said additional concentrating means comprising a cylindrically shaped concentrating electrode; means for supplying said Wehnelt cylinder with a negative bias with respect to the cathode and with a control voltage; means for supplying said anode with a high positive potential with respect to said cathode; and means for supplying said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

7. A television arrangement comprising in combination a Braun tube comprising an envelope enclosing a cathode, a picture receiving screen, a Wehnelt cylinder surounding said cathode, an anode mounted between said cathode and said picture receiving screen, two pairs of deflecting plates mounted between said anode and said screen for deflecting the cathode ray in two directions perpendicular to one another for scanning said screen, and additional concentrating means mounted between said anode and said deflecting plates, said additional concentrating means comprising a cylindrically shaped concentrating electrode spaced from said deflecting plates for at least fifteen mm. for avoiding an influence of said deflecting plates upon said additional concentrating means; means for supplying said Wehnelt cylinder with a control voltage; means for supplying said anode with a high positive po-

tential with respect to said cathode; and means for supplying said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

8. A Braun tube comprising an envelope enclosing a cathode, a picture receiving screen, an electron-concentrating system mounted between said cathode and said screen, and two pairs of deflecting plates mounted between said concentrating system and said screen, said deflecting plates being spaced from the last electrode of said concentrating system for at least fifteen mm. for preventing disturbing influences of the deflecting plates upon the concentration of the cathode.

9. In a television reception arrangement a Braun tube comprising electrodes to produce, electrodes to control, and electrodes to concentrate the cathode ray, a fluorescent screen and two pairs of deflecting plates for deflecting the ray in two directions perpendicular to one another for the purpose of scanning the screen, means to supply said electrodes and said deflecting plates with operating potentials partly having fluctuating differences between each other in the manner well known in the art, and means to screen off against each other such of said electrodes and deflecting plates—the two deflecting plates forming a pair excluded—as possess fluctuating potential differences.

10. In a television reception arrangement a Braun tube comprising a cathode and an apertured anode for producing a cathode ray, a fluorescent screen, and deflecting means mounted between said cathode and said anode for deflecting the cathode ray in order to vary the fraction of the ray able to pass through said apertured anode, and means for applying to said deflecting means a constant initial potential of such an extent that, when an intensity modulated high frequency oscillation is directly applied to said deflecting means the cathode ray, upon the occurrence of the minimum amplitude is just completely shuttered by said anode.

11. In a television reception arrangement a Braun tube comprising a cathode and an apertured anode for producing a cathode ray, a fluorescent screen, and deflecting means mounted between said cathode and said anode for deflecting the cathode ray in order to vary the fraction of the ray able to pass through said apertured anode, and means for applying to said deflecting means a constant initial potential of such an extent that, when an intensity modulated high frequency oscillation is directly applied to said deflecting means the cathode ray, upon the occurrence of the minimum amplitude is just completely capable of passing through said apertured anode.

12. In a television reception arrangement in combination a Braun tube comprising a cathode and a plate-shaped anode furnished with a small aperture arranged in operative relationship thereto, at least one deflecting electrode arranged between said cathode and said anode in operative relationship to said aperture of said anode, a picture receiving screen, deflecting means arranged between said picture receiving screen and said anode and means for maintaining constant the direction as well as the position of the path along which the cathode ray enters the space wherein it is deflected, said means being arranged between said anode and said deflecting means and including a cylindrically shaped concentrating electrode; means including a series resistance to supply said deflecting electrode with a bias and with a control voltage; means to supply said anode with a high positive potential in relation to said cathode; and means to supply said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

13. In a television reception arrangement in combination a Braun tube comprising a cathode and a plate-shaped anode furnished with a small aperture arranged in operative relationship thereto, at least one deflecting electrode arranged between said cathode and said anode in operative relationship to said aperture of said anode, a picture receiving screen, deflecting means arranged between said picture receiving screen and said anode and means for maintaining constant the direction as well as the position of the path along which the cathode ray enters the space wherein it is deflected, said means being arranged between said anode and said deflecting means and including a cylindrically shaped concentrating electrode; means to supply said deflecting electrode with a bias; means including a coupling condenser to supply said deflecting electrode, with a control voltage; means to supply said anode with a high positive potential in relation to said cathode; and means to supply said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

14. An arrangement as claimed in claim 1, wherein the means to supply said deflecting plate with a bias and the means to supply said concentrating electrode with a potential both comprise one and the same potentiometer.

15. In a television reception arrangement in combination a Braun tube comprising a cathode and a plate shaped anode furnished with a small aperture arranged in operative relationship thereto, a Wehnelt cylinder surrounding said cathode, at least one deflecting electrode arranged between said cathode and said anode in operative relationship to said aperture of said anode, a picture receiving screen, deflecting means arranged between said picture receiving screen and said anode and means for maintaining constant the direction as well as the position of the path along which the cathode ray enters the space wherein it is deflected, said means being arranged between said anode and said deflecting means and including a cylindrically shaped concentrating electrode; means to supply said Wehnelt cylinder with a negative potential relatively to said cathode, means to supply said deflecting electrode with a bias and with a control voltage; means to supply said anode with a high positive potential in relation to said cathode; and means to supply said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

16. In a television reception arrangement in combination a Braun tube comprising a cathode and a plate-shaped anode furnished with a small aperture arranged in operative relationship thereto, a plate-shaped apertured electrode mounted in front of said cathode, at least one deflecting electrode arranged between said cathode and said anode in operative relationship to said aperture of said anode, a picture receiving screen, deflecting means arranged between said picture receiving screen and said anode and means for maintaining constant the direction as well as the position of the path along which the cathode ray

enters the space wherein it is deflected, said means being arranged between said anode and said deflecting means and including a cylindrically shaped concentrating electrode; means to supply said deflecting electrode with a bias and with a control voltage; means to supply said anode with a high positive potential in relation to said cathode; and means to supply said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

17. In a television reception arrangement in combination a Braun tube comprising a cathode and a plate-shaped anode furnished with a small aperture arranged in operative relationship thereto, a Wehnelt cylinder surrounding said cathode, a plate-shaped apertured electrode mounted in front of said cathode, at least one deflecting electrode arranged between said cathode and said anode in operative relationship to said aperture of said anode, a picture receiving screen, deflecting means arranged between said picture receiving screen and said anode and means for maintaining constant the direction as well as the position of the path along which the cathode ray enters the space wherein it is deflected, said means being arranged between said anode and said deflecting means and including a cylindrically shaped concentrating electrode; means to supply said deflecting electrode with a bias and with a control voltage; means to supply said anode with a high positive potential in relation to said cathode; and means to supply said concentrating electrode with a potential which is lower than that of said anode but higher than that of said cathode.

18. In a television reception arrangement a Braun tube comprising means to produce, means to control and means to concentrate a cathode ray, a fluorescent screen, and two pairs of deflecting plates for deflecting the ray in two directions perpendicular to one another for the purpose of scanning the screen, and means for applying to said controlling means modulated high-frequency oscillations which are not rectified.

19. In a television reception arrangement in combination a Braun tube comprising a cathode and an anode mounted in operative relationship thereto, a plate-shaped apertured electrode mounted in front of said cathode, a picture receiving screen, means for deflecting the cathode ray in two directions perpendicular to one another for scanning said screen, said deflecting means being mounted between said anode and said screen, and concentrating means comprising a cylindrically shaped electrode mounted between said anode and said deflecting means; means for supplying said anode with a high positive bias with respect to said cathode and means for supplying said electrode with a potential which is lower than the potential of said anode but higher than that of said cathode.

20. In a television reception arrangement in combination a Braun tube comprising a cathode and an anode mounted in operative relationship thereto, a Wehnelt cylinder surrounding said cathode, a plate-shaped apertured electrode mounted in front of said cathode, a picture receiving screen, means for deflecting the cathode ray in two directions perpendicular to one another for scanning said screen, said deflecting means being mounted between said anode and said screen, and concentrating means comprising a cylindrically shaped electrode mounted between said anode and said deflecting means, means for maintaining said Wehnelt cylinder negative relatively to said cathode, means for supplying said anode with a high positive bias with respect to said cathode, and means for supplying said electrode with a potential which is lower than the potential of said anode but higher than that of said cathode.

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