

Oct. 26, 1943.

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2,332,881

CATHODE RAY TUBE ARRANGEMENT

Filed Nov. 24, 1939

2 Sheets-Sheet 1

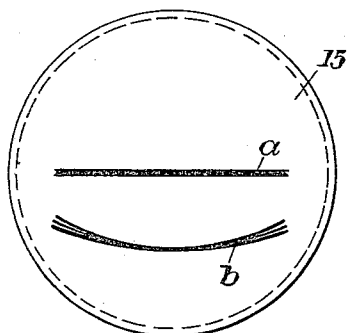


Fig. 1.

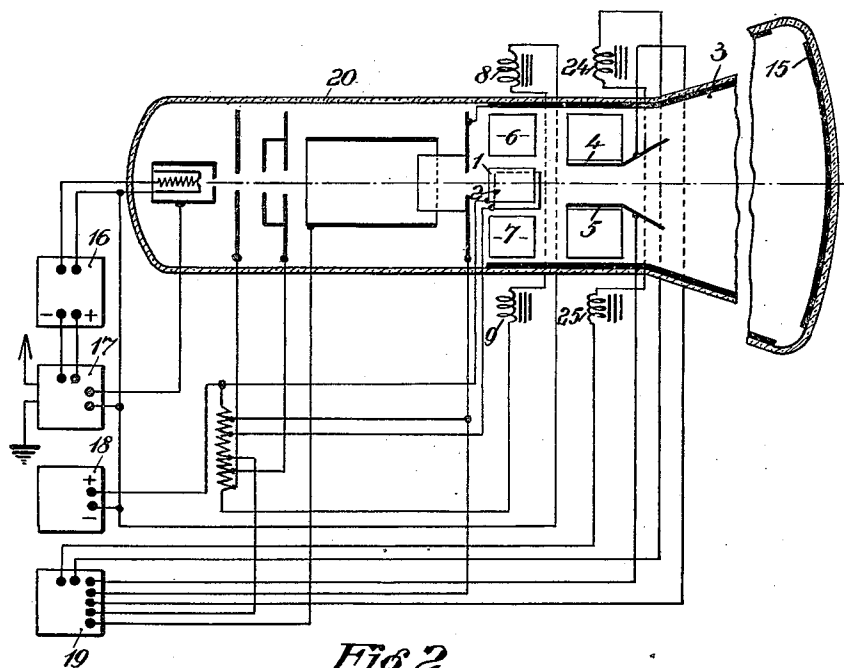


Fig. 2.

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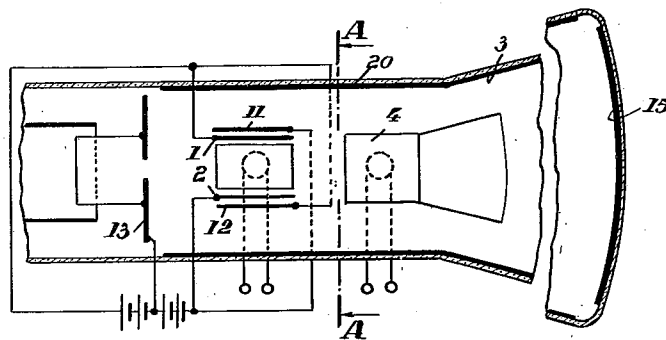


Fig. 3

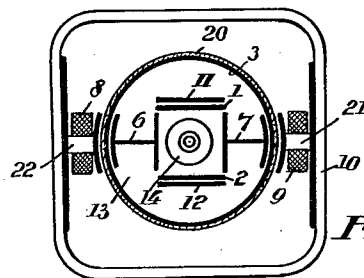


Fig. 4

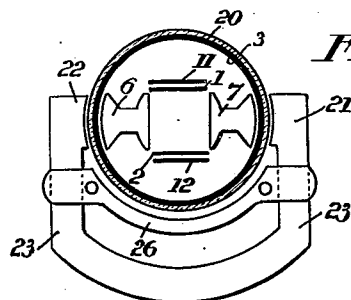


Fig. 5

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UNITED STATES PATENT OFFICE

2,332,881

CATHODE RAY TUBE ARRANGEMENT

Friedrich Woerner, Berlin, Germany; vested in
the Alien Property CustodianApplication November 24, 1939, Serial No. 305,967
In Germany November 30, 1938

3 Claims. (Cl. 250—157)

The present invention relates to arrangements more particularly for television purposes comprising a cathode ray tube provided with a luminescent screen and means for deflecting the cathode ray to scan said screen.

The arrangement according to the invention is an improvement and modification of the arrangement described in the co-pending application Serial No. 239,153, filed November 15, 1938. In this prior application means are disclosed for preventing the negative ions from destroying the luminescent material at those parts of the screen which are hit by the ions. Luminescent materials consisting of a sulphide have proved to be particularly liable to the influence of the ions, while, on the other hand, they are distinguished by a high luminous efficiency and a colour of emitted radiation which is particularly suitable for television purposes. The detrimental effect caused by the negative ions becomes remarkable especially when magnetic means are used for the deflection of the cathode ray in at least one direction.

In the case of a combined electrostatic and electromagnetic deflection, after a rather short period of operation, there is observed a dark line on the luminescent screen which extends transversely through the image field parallel to the magnetic and electric lines of force. When magnetic deflection takes place in both directions, a dark spot appears at the centre of the screen.

It is an object of the present invention to provide improved means which prevent the appearance of the just described interference and at the same time allow an undisturbed deflection and focusing of the cathode ray.

The present invention will be better understood from, and further features of the invention will appear in connection with the following more detailed description and the accompanying drawings of which, in a purely diagrammatic fashion and by way of example,

Figure 1 represents the luminescent screen of a cathode ray tube showing two different lines drawn by the cathode ray when acted upon by the periodical deflection in only one direction.

Figure 2 shows a substantially cross-sectional view taken in a horizontal plane, of a tube according to the invention and the essential parts of the external circuits necessary for operating the tube.

Figure 3 is a substantially cross-sectional view taken in a vertical plane and partly broken away, of a tube according to the invention, showing a

modification of the deflecting system of Figure 2 and some further circuit elements.

Figure 4 is a section perpendicular to the tube axis of the tube of Figure 3, taken substantially along the plane A—A of Figure 3 and viewed from the side of the luminescent screen, and

Figure 5 is a view similar to Figure 4 showing a modification.

In the above cited prior application, a pre-deflecting condenser consisting of the plates 1—2 of Figure 2 is described which is arranged, seen in the direction of the electron beam, in front of the "main" deflecting system, i. e., the system which performs the periodical deflection of the ray for scanning the screen. As shown in Figures 2 and 3, the main system may consist of a condenser 4—5 for the purpose of electrostatic deflection and a pair of coils 24—25 for the purpose of electromagnetic deflection. The pre-deflecting condenser imparts to the cathode ray such a direction that the ray, when the main deflecting system is not in operation would impinge upon the edges of the screen beyond the picture area. By an additional direct current which is caused to flow through the main deflecting coils the ray is guided back to the centre of the picture area. The ions respond only to the electrostatic influence while the electrons are deflected by both the electrostatic and the electromagnetic fields. In this way the interfering effect is removed from the picture area.

When carrying out this method described in the prior application for removing the ion line in a television tube operating with a combined electrostatic and electromagnetic deflection, one encounters the following difficulty: The cathode ray, in its rest position, after being deflected back to the centre of the screen by the D. C. component of the current to the deflecting coils, does not any longer move along the tube axis. In the space between the deflecting plates and the screen the path of the ray is inclined by a certain angle with respect to the axis. Therefore the various positions of the ray are no longer symmetrical with respect to the marginal field of the main deflecting system, especially that between the deflecting plates 4—5 and the wall coating 3 provided inside the tube on the glass wall 20 within the neck and/or bulb portion facing the screen 15 of the tube for removing undesired wall charges.

In operation, if the cathode ray is acted upon only by the electrostatic main deflection, the straight line *a* of Figure 1 passing through the centre of the picture area, is drawn on the screen

15. When the predeflecting system is caused to operate, there results not only the desired shifting of this line towards the edge of the picture area, but the formerly straight line is circularly curved, substantially as shown by line *b* of Figure 1. Further the luminous spot is greatly distorted at the points of largest deflection. The widening of the spot can go so far that, when the intensity of the ray is controlled by means of a net-shaped electrode, the single partial rays passing through the meshes of the net, are visible at the ends of the line *b*. The just mentioned disadvantage remains existing even when the electron ray is directed back to the center of the screen by the above described magnetic deflection, since the ray no longer enters the main deflecting space in a central position.

The method as described in the foregoing for eliminating the black line is practicable only if the neck portion of the tube is made unusually wide or if the auxiliary plates 1—2 as well as the deflecting plates 4—5 project into the enlarged front part of the tube body. The auxiliary plates 1—2 must be arranged at least at the joint of the cylindrical and the conical part of the glass body. This condition, moreover, is known, for the case that a double electrostatic deflecting system is used. When a combined electrostatic and electromagnetic deflecting system is provided, however, an arrangement of this kind involves considerable impediments in manufacture since it is difficult to conduct the magnetic deflecting field from outside the tube exactly to the desired place, i. e., the space of the deflecting plates 4—5 which latter preferably consist of magnetic material and serve at the same time as pole pieces for the deflecting magnets.

According to the invention, the above described difficulties are completely eliminated by providing a separate auxiliary magnetic field for again deflecting the electron ray back to the axial direction, the ray being first deflected by the predeflecting condenser 1—2.

In a preferred embodiment of the invention the auxiliary magnetic field is superposed to the electric field of the predeflecting condenser consisting of plates 1 and 2, in such a way that the lines of force of the electric and magnetic field are substantially perpendicular to one another, and that both fields act upon the corpuscles forming the ray substantially at the same time and within the same space.

The auxiliary magnetic field is produced by two coils 8 and 9 mounted outside the tube, and is limited to a definite space along the path of the cathode ray by means of pole pieces 6 and 7 mounted inside the tube wall. The length as well as the strength of both the electric and the magnetic field can be adapted to one another by trial.

When both fields are suitably adjusted, the simultaneous influence of the electric and magnetic field causes a nearly rectilinear path of the electron ray through the auxiliary deflecting system while the ions are affected substantially only by the electrostatic field, the extent and strength of which are so dimensioned that the ions are deflected out of the picture area.

Preferably the longitudinal extent of the magnetic field which can be governed by suitably forming the pole pieces 6 and 7, is made as small as possible in order to avoid a disturbance of the electron ray within the main lens caused by the magnetic stray field.

In the circuit shown in Figure 2, 16 represents the low voltage power supply, 17 the television receiver, 18 the high voltage power supply, and 19 the time base oscillation generator.

5 In Figures 3 and 4, further additional measures are represented which may be necessary for obtaining an unobjectionable efficiency of the device. It is useful to compensate the marginal field of the predeflecting condenser in its outer space. For this purpose a further pair of auxiliary plates 11—12 is provided which are arranged parallel to plates 1 and 2 and are furnished with suitable potentials for producing opposing electrostatic fields. Preferably plate 11 is electrically connected inside the tube with plate 2, and plate 12, in a corresponding manner, is connected with plate 1. Opposing fields for compensating the marginal field of the predeflecting condenser, of course, can also be produced in other ways. For example, instead of plates 11 and 12, narrow metallic strips, arranged at the entrance and exit edges of the predeflecting condenser and provided with suitable potentials with respect to plates 1 and 2, can be used.

10 In Figure 4, 10 is a magnetic yoke provided with magnet poles 21—22 supporting coils 8—9 and being supplied with pole pieces. This part of the arrangement is mounted outside the tube wall 20. Element 13 is the reproducing lens anode having an aperture 14, viewed from the side of the screen. The pole pieces 6 and 7 arranged inside the tube wall are suitably shaped and may consist, for example, of iron-plate boxes. Preferably they are electrically insulated from plates 1 and 2.

15 The advantage of the described arrangement lies in the fact that the spacing between plates 1 and 2 need not be substantially larger than the diameter of the cathode ray within the predeflecting space. In this way the necessary longitudinal extent of the electrostatic field at a given deflecting voltage, or the necessary deflecting voltage at a given longitudinal extent of the field, are minimized. The expenditure required for producing the additional magnetic field is insignificant since the magnetic field in question is a static one. The necessary number of ampere-turns can be obtained by providing a large number of turns for coils 8 and 9 but using a current of low intensity which may be taken from the high tension power supply.

20 In a modified embodiment of the invention which is illustrated by Figure 5, the electromagnets are replaced by a permanent steel magnet 23 having suitably shaped narrow magnet poles 21—22 and being provided with a magnetic shunt 26 for adjusting the field intensity.

25 The arrangement as described at the same time makes it possible to shift the picture area in a vertical direction without further additional means, in order to adjust the position of the picture area with respect to the image window of the television receiver case.

I claim:

30 1. In a discharge tube arrangement a cathode ray tube comprising a luminescent screen, means including a cathode and an anode for producing a corpuscular ray consisting of negatively charged particles and for focusing said ray on said screen, a deflecting system arranged between said anode and said screen and comprising a pair of magnet coils, for deflecting said ray in two mutually perpendicular directions, a pair of deflecting plates mounted inside the tube between said anode and said deflecting system, means for ap-

plying a constant potential difference between the plates of said pair of such an amount that the ions of said ray after emergence from the space between said plates are directed out of the picture area of said screen, means including a permanent steel magnet mounted outside said tube and a pair of pole pieces mounted inside said tube for producing a constant magnetic field substantially within the space between said plates of such an intensity that the electrons of said ray in the stationary position of said ray impinge upon the centre of said screen, and a variable magnetic shunt for adjusting the strength of said constant magnetic field.

2. In a discharge tube arrangement a cathode ray tube comprising a luminescent screen, means including a cathode and an anode for producing a corpuscular ray consisting of negatively charged particles and for focusing said ray on said screen, a deflecting system arranged between said anode and said screen and comprising a pair of magnet coils, for deflecting said ray in two mutually perpendicular directions, a pair of deflecting plates mounted between said anode and said deflecting system, means for applying a constant potential difference between the plates of said pair of such an amount that the ions of said ray after emergence from the space between said plates are directed out of the picture area of said screen, at least two further electrodes mounted adjacent to and parallel with the entrance and exit edges of said pair of plates, means for connecting each of said further electrodes with

the more remote plate of said pair of plates, for compensating the marginal field of said pair of deflecting plates, and means for producing a constant magnetic field substantially within the space between said plates of such an intensity that the electrons of said ray in the stationary position of said ray impinge upon the centre of said screen.

3. In a discharge tube arrangement a cathode ray tube comprising a luminescent screen, means including a cathode and an anode for producing a corpuscular ray consisting of negatively charged particles and for focusing said ray on said screen, a deflecting system arranged between said anode and said screen and comprising a pair of magnet coils, for deflecting said ray in two mutually perpendicular directions, a pair of deflecting plates mounted inside said tube between said anode and said screen, means for applying a constant potential difference between the plates of said pair of such an amount that the ions of said ray after emergence from the space between said plates are directed out of the picture area of said screen, means including a permanent steel magnet for producing a constant magnetic field substantially within the space between said plates of such an intensity that the electrons of said ray in the stationary position of said ray impinge upon the centre of said screen, and a variable magnetic shunt for adjusting the strength of said constant magnetic field.

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