April 13, 1937. M. VON ARDENNE ET AL 2,077,288

CATHODE RAY TUBE

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Fig. 1.

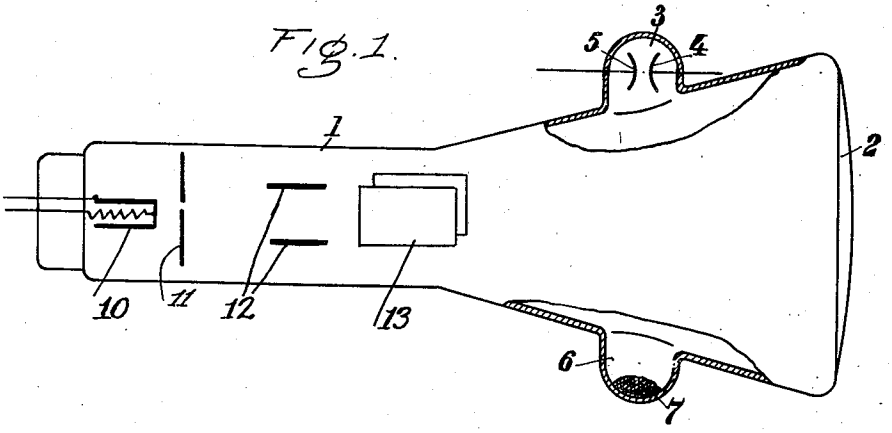
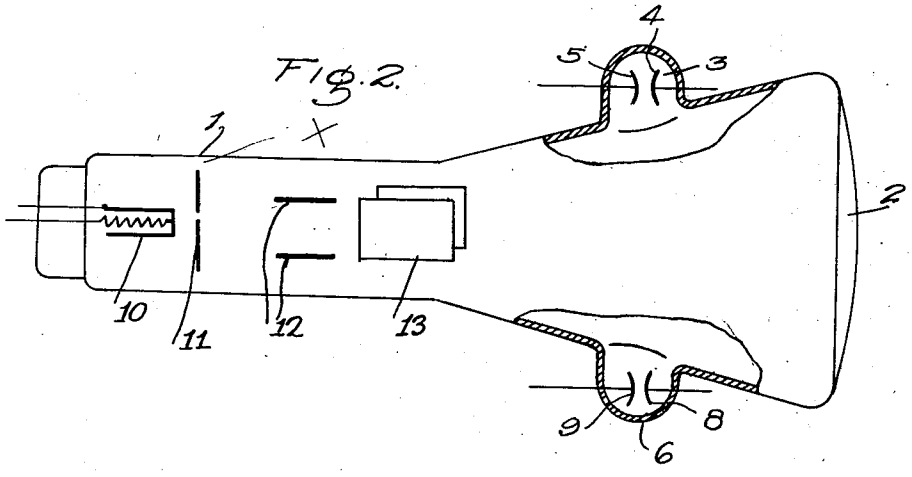


Fig. 2.



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CATHODE RAY TUBE

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12 Claims. (Cl. 250—27.5)

The present invention relates to Braun tubes and similar cathode ray recorders, cathode ray oscillographs, Braun tubes for television purposes and the like, in which deflection of the cathode ray out of its original direction is performed by special auxiliary elements, and more particularly deflecting plates. Apparatus of this nature are accompanied by the fact that with increasing rate of deflection there occurs a widening of the cathode ray following its deflection, and accordingly a widening of the fluorescent spot.

This dispersion of the cathode ray, which accordingly depends on the rate of deflection thereof, would appear to be due to the following reason: The cathode ray is formed by a plurality of electrons, which advance in the direction of the ray at a very high speed—approximately 1/30–$\frac{1}{10}$ the speed of light. The space charge cloud formed by this ionic ray now attempts to disintegrate insofar as special means are not provided for wholly or practically maintaining the concentration of the ray. Now the cathode ray certainly creates by ionization by way of collision in the existing gas a certain number of positive ions which, however, are not sufficient either in their number or in their effective cross-section to compensate the spreading forces of the space charge cloud. This is due on the one hand to the fact that the ions possess merely a short life, and generally speaking, due to the relatively slow kinetic rate of movement, are unable to follow up the moved cathode ray, and accordingly are left back by the ray, in which the same shortly before constituted an embedded positive charge which prevented dispersion of the space charge.

According to the invention, a gas, therefore, is employed, which possesses a very high kinetic speed, preferably hydrogen gas, a gas, therefore, the ions of which diffuse with the greatest rapidity, and accordingly result in a very large effective cross-section. An additional requirement for accomplishing an appreciable effective cross-section is, as stated above, a duration as lengthy as possible of the positive ions in the gas employed. When employing a gas according to the invention the positive ion charges contained in the ionic ray will, assuming the rate of deflection is not over-excessive, follow the cathode ray upon the deflection thereof and, insofar as due to the Maxwell rate of distribution they are unable to do this, will be replaced by new ions present at the particular point touched by the cathode ray or generated by reason of ionization by collision.

When employing hydrogen gas for the space traversed by the deflected cathode ray there will preferably be used a tungsten thorium cathode. Barium alloy cathodes, however, are also suitable for discharge vessels of this nature.

According to the additional subject matter of the invention, the space traversed by the cathode ray is ionized by special ionization sources. Suitable for this purpose are certain known hot electrodes, light arcs, mercury arcs, radio-active substances and the like. In the most convenient fashion, however, the ionization will be performed by glow discharge between special auxiliary electrodes. When employing an ionized space, it is no longer of considerable importance what nature of gas is made use of, as ions will exist in sufficient number at the particular points touched by the ray. On the other hand, however, the ionization of the space should not be carried to such extent that the ionic ray is neutralized prior to touching the fluorescent layer. It is furthermore essential that the ionization of the space takes place as evenly as possible in order to avoid fluctuations in the focussing of the ray.

As already stated above, certain hot electrodes may be made use of for creating the positive ions. According to the additional subject matter of the invention, the one electrode is to be employed for creating both the negative electrons as well as the positive ions ionizing the space. From a practical standpoint this may be accomplished in simple fashion in such manner that the electrons emitted by the hot cathode receive their acceleration from the anode field of the Braun tube, whilst the emitted ions are moved for the greater part through the field of a special auxiliary cathode, i. e., in such manner, therefore, that the hot electrode on the one hand forms the cathode of the Braun tube and on the other hand the anode of the ion-generating device.

In the figures of the appended drawing some possible embodiments of this invention are illustrated.

In Fig. 1, means of 2 different kinds for producing the auxiliary ionization are illustrated, viz., one auxiliary discharge gap and a radio-active substance, whereas Fig. 2 illustrates the provision of two auxiliary discharge gaps.

The embodiment of our invention wherein only one additional auxiliary electrode is provided co-acting with the cathode of the cathode ray tube, has not been shown.

In both figures, 1 is the cathode ray tube which may be filled with gas of an adapted pressure

and which may contain any desirable electrode system, comprising for instance a cathode 10, an anode 11 and deflecting elements which may consist of pairs 12 and 13 of deflecting plates. 2 is the fluorescent screen, 3 and 6 are the tubular chambers opened to the gas room of the cathode ray tube and wherein, in the arrangement according to Fig. 1, either the auxiliary electrodes 4 and 5 or the radio-active substance 7 may be arranged to produce the auxiliary ionization.

In Fig. 2, 4 and 5 on the one hand, 8 and 9 on the other hand, are the two pairs of auxiliary electrodes.

We claim:

1. A cathode-ray tube comprising hydrogen-filling a hot cathode, an anode arranged in operative relationship thereto for producing a cathode ray, said cathode ray ionizing the gas-filling and acting in this way as means for initiating ionization, a plurality of deflecting plates, and additional means for initiating ionization, comprising two pairs of auxiliary electrodes arranged symmetrically to one another.

2. A cathode-ray tube comprising hydrogen-filling a hot cathode, an anode arranged in operative relationship thereto for producing a cathode ray, said cathode ray ionizing the gas-filling and acting in this way as means for initiating ionization, a plurality of deflecting plates, and additional means for initiating ionization, comprising two pairs of auxiliary electrodes arranged symmetrically to one another inside of separate tubular chambers.

3. In an electric discharge device the combination comprising means to produce a cathode ray, a permanent gas atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection.

4. In an electric discharge device the combination comprising means to produce a cathode ray, a permanent hydrogen atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection.

5. In an electric discharge device the combination comprising means to produce a cathode ray, means to deflect the cathode ray, a permanent gas atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection.

6. The combination comprising an electric discharge device, means to produce a cathode ray in said discharge device, means to deflect the cathode ray, a permanent gas-atmosphere in said discharge device adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection.

7. In an electric discharge device the combination comprising means to produce a cathode ray, a permanent gas atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection, said auxiliary ionic source comprising auxiliary electrodes.

8. In an electric discharge device the combination comprising means to produce a cathode ray, a permanent hydrogen atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection, said auxiliary source comprising auxiliary electrodes.

9. In an electric discharge device the combination comprising means to produce a cathode ray, means to deflect the cathode ray, a permanent gas atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection, said auxiliary ionic source comprising auxiliary electrodes.

10. In an electric discharge device the combination comprising means to produce a cathode ray, a permanent gas atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection, said auxiliary ionic source comprising auxiliary electrodes, one of said electrodes being employed as electronic source for the cathode ray.

11. In an electric discharge device the combination comprising means to produce a cathode ray, a permanent hydrogen atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection, said auxiliary ionic source comprising auxiliary electrodes, one of said electrodes being employed as electronic source for the cathode ray.

12. In an electric discharge device the combination comprising means to produce a cathode ray, means to deflect the cathode ray, a permanent gas atmosphere adapted to become ionized when traversed by the cathode ray, and an auxiliary ionic source for maintaining the focussing of the cathode ray even in the case of high and fluctuating rates of deflection, said auxiliary ionic source comprising auxiliary electrodes, one of said electrodes being employed as electronic source for the cathode ray.

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